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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Inter-oceanic Ship Canal via the Atrato and Truando Rivers. By EDWARD W. SERRELL, Civ. Eng.

For many years attempts have been made by several of the most enlightened governments of the world, and by enterprising individuals, to determine the practicability of connecting the Atlantic and Pacific Oceans *by water*, artificially.

The minds of those who have investigated the subject most closely, and among them the great Humboldt, seem to have rested on three localities, namely, the Isthmuses of Nicaragua and Panama, and the Atrato river.

The latter, probably owing to the considerable breadth of the country, has, until very recently, received but little attention.

During the past four years, however, many very elaborate surveys have been made on its waters and tributaries, and the surrounding country. These examinations have been conducted by Mr. John C. Trautwine, Mr. James C. Lane, and Captain William Kennish, and the several corps under their directions.

They have been undertaken at the instance of American merchants; the expenses of the last two surveys, and of obtaining the rights to construct the works, have been borne by Mr. Frederick M. Kelley, of New York.

The Atrato is a broad and deep river. For seventy miles from its mouth it has an average depth of forty-seven feet, and the channel-way for this distance is from eight hundred to twelve hundred feet in width.

At the mouths of the river, which finds its way into the Gulf of Uraba or Darien by nine bocas or estuaries, there are bars formed from sedimentary deposits, and the water is only four or five feet deep.

The bay itself is very ample, and deep enough for the largest vessels.

The line for the contemplated connexion between the oceans, ascends the Atrato sixty-three miles; it then enters the valley of a tributary known as the Truando, which is followed for thirty-six miles.

This river is now navigable for vessels drawing twelve feet of water, for thirty-eight miles from its confluence with the Atrato.

From the Atrato, for thirty-six miles, it is intended to deepen and widen the Truando, and then to make an open cut through rock twenty-five miles to the Pacific Ocean.

The cut will average ninety-six feet deep, excepting a tunnel, three and a quarter miles in length.

It is contemplated to make the prism of the canal, two hundred feet wide and thirty feet deep at extreme low tide.

The river Atrato flows at the rate of about two and a half miles per hour, and the point of confluence with the Atrato, as determined by Mr. Kennish, is 15·2 above mean level in the oceans.

On the Pacific there is a rise and fall of the tide at the outlet, of twelve feet three-tenths. At the mouth of the Atrato on the Atlantic, there is but twenty inches rise and fall. So that when the cut is complete, the Atrato will have two mouths, one emptying into the Atlantic, and the other into the Pacific. The passage from ocean to ocean will be up one mouth and down the other.

The currents in these channels will, on the Atlantic side, be varied but little from what it now is, as the head will be reduced but about one foot, as determined by the comparison of the sections of the streams, and the quantity of supply.

The velocity of the water through the new channel, at high water in the Pacific, will be equal to that which is due to a head of 14 feet, minus six feet one and a half tenths; and at low tide 14 feet plus 6·25; so that without reference to the *flow* of the tide *into* and *out of* the cut, which however will equilibrate it, the current in mean will be essentially the same as to the Atlantic, excepting that which is due to greater straightness in the new channel.

All the material necessary for constructions upon the line of the work exist in the country, excepting the metals.

An excellent harbor already exists at the Atlantic terminus, and on the Pacific but little labor is required to make the harbor there equal to any for safety and accessibility on the coast.

The distinctive features of this route are, an inter-oceanic connexion, having depth and width sufficient to pass the largest vessels abreast now afloat, and upon which no locks or any other obstructions of any kind will occur, and that there are good harbors at either end.

The country through which the line passes where the constructions and deepening of the river Truando have to be done, is very healthy and productive.

On the Atrato, the only unhealthy part of the route, there is no work

to be done, except at the bars of the mouth, and here the climate is comparatively salubrious from the constant sea breezes.

In making the surveys, very ample notes of the geology, botany, and sylvia, have been taken, and the sanitary condition of the country at the various locations, together with the meteorological changes, have been noted.

Mr. Serrell has estimated the cost of the work, predicated on the data furnished by Mr. Kennish, at one hundred and forty-seven millions of dollars.

Several of the most eminent engineers in the country have been consulted, and corroborate this estimate.

By the data furnished from Mr. Stone's commercial statements of the present trade of the world, it has also been estimated that the present business between the two oceans, that would pass through this Canal, if now in use, without making allowance for any increase, would pay twelve per cent. on a cost of two hundred millions of dollars, and then save to itself six per cent. or upwards of three hundred and eighty millions of dollars.

It has also been estimated that twenty-five thousand men will have to be constantly employed for twelve years to build the work.

This number can be maintained and sustained, as the average haul for supplies from water carriage is only twelve miles, and the location where the work is to be done, is healthy.

The Federal government of the United States proposes to verify the surveys; France and England have been asked to participate.

The necessary grants and treaties have been perfected, by which the route is secured, and a financial plan is now being digested upon which it is proposed to commence and prosecute the construction of the work vigorously.

For the Journal of the Franklin Institute.

Bridge Foundations.—Description of the Mode of Founding the Piers of the Ohio and Pennsylvania Railroad Bridge, across the Allegheny River at Pittsburgh. By Solomon W. Roberts, Chf. Eng.

The city of Pittsburgh and the city of Allegheny are separated by the Allegheny river, which is a stream about twelve hundred feet wide, and which sometimes rises to the height of thirty feet above low water mark. Such great floods are, however, very rare, but a rise of twelve or fifteen feet is a common occurrence, and the current is then very strong. The bottom of the river, to an unknown depth, consists of a mass of gravel, mixed with bolder stones of the size commonly used for street paving, and occasionally containing water-worn stones of a much larger size. The depth of the stream at low water is very irregular, and while at some places the gravel bottom will be dry, at others the water will be from fifteen to twenty feet deep.

The river is badly adapted to the construction of coffer dams, on account of the porous nature of the gravel bottom, through which water readily flows; and because they would be exposed to injury from frequent

freshets, even if it was possible to pump the water out of the coffer dams, within any reasonable limits of cost.

In order to make the best connexion between the two railroads, the site selected for the Ohio and Pennsylvania railroad bridge is opposite the passenger station of the Pennsylvania railroad, in Pittsburgh. It also has the advantage of convenient approaches on both sides of the river, without interfering with any valuable buildings. The bottom of the river at the site of the bridge is, however, very irregular, varying in depth at low water, from one foot to fourteen feet.

After the bottom of the river had been carefully sounded, and a correct cross-section made of it; it was determined to found the piers by excavating pits for them, by means of a steam dredging machine working on a boat, and by sinking heavy cribs, or solid masses of large square timber, below low water, on which to start the masonry.

This plan has been carried out with entire success, and with very little difficulty. Several of the piers, which are built of very heavy masonry laid in cement, are now approaching completion, and they show no signs of settlement whatever. The work in the river was begun on the 16th of August, 1854, and the foundation of the fifth pier was put in on the 5th of November following, being less than three months from the commencement of the work. The remaining pier is in shallow water near the shore, and the abutments are both upon dry land. The height of the piers from low water mark to the under side of the bridge superstructure, is thirty-eight feet, and the depth of the timber foundations under two of the piers, is twelve feet.

The pits, as excavated by the dredging machine, varied in depth from five to thirteen feet below low water, the object being to obtain a level and uniform foundation. Each pit was about sixty-eight feet long and twenty-six feet wide on the bottom, and the cost of excavating and removing the gravel by contract, was fifty cents per cubic yard. By the careful use of the buckets of the dredging machine, and occasionally of a heavy iron rake, the bottoms of the pits were made very smooth and even. One large stone which could not be removed by the means at hand, was sunk in a hole dug for the purpose alongside of the pit.

The timber foundations were constructed of white pine timber, sawed square, and one foot thick. They were built afloat in the river, the first course of timbers being twenty-four feet long, and laid side by side, across the line of the pier. The second course crossed the first at right angles, and was bolted to it with iron rag bolts. The third course, bolted to the second, ran in the same direction as the first. In this way an exceedingly strong foundation was constructed of solid timber, three feet thick, and large enough to distribute the weight to be supported over an extensive surface, sixty-six feet long by twenty-four feet wide. The masonry of each pier, at low water mark, is fourteen feet and a half thick, and its extreme length is sixty-three and a half feet, the ends being semi-circular. The top of the timber foundation is eighteen feet three inches broad, and sixty five feet long. After the first three courses of timber were laid, the additional courses were drawn in on the sides, by a succession of stops, so as to reduce the timber work to these dimensions on the top; and the upper

course was planked with three-inch plank, on which the masonry was started.

Experience showed that where the water was deep, and the foundations consisted of a good many courses of timber, it was expedient to leave some spaces between the timbers and fill them with stone, so that the whole mass might be but little lighter than an equal bulk of water, in order that the top of the timber foundation might float but little above the water, and be about level with the decks of the flat boats loaded with dressed stone for the pier, which lay on each side of the foundation to steady it. The first course of the pier masonry was thus laid in the most convenient manner, the river being low ; and the weight of the stone work sunk the foundation down upon its permanent bed and in its appropriate place. The men were not required to work in the water, and all expense for pumping was avoided.

After the foundations were thus sunk in the manner desired, a large quantity of heavy loose stone, or rip rap, was placed around them, to secure them from the scouring action of the river.

The durability of the timber is secured by its being always under water, and of the permanence of the structure there is no doubt.

Canals and Railways in India. An abstract of paper read before the Royal Society of Arts. By W. Bridges Adams.*

Continued from page 221.

[Mr. Adams then went on to describe the construction of wheels on railways, and their defects, and the essential principles of their improvement. He thus continued :]

It is a common remark by persons of not very logical minds, that a thing is very well in theory, but will not do in practice. If this mean anything, it is that the theory is a false one. A man putting forth a false theory may do so either honestly or ignorantly, and in neither case ought he to be implicitly trusted ; but precisely the same remark applies to those who refuse to admit a true theory, or who suffer a true theory to fall dead for want of application. To the clear, perceptive mind, the true theory is as true and certain as the demonstration by practice.

To illustrate the theory of rails which I have set forth, the large model on the table represents a rail of girder form, deep and wide, to give vertical and horizontal strength. The top of the rail is elevated less than 3 inches above the bearing on the ballast, while the width is 13 inches, or a proportion of about 26 to 5 in favor of steadiness. The total depth of the rail is 7 inches; and of this 4½ inches serve as a keel, to give additional steadiness by holding laterally in the ballast. The tie-bars keep the gauge. The packing is very accessible, and the rail is really reversible. The rails and side brackets break joint mutually, and the manufacture is easily producible, and any part can be replaced without much waste. There are but four parts or types, and the commonest laborers can lay them down without error, while the whole is of wrought iron,

* From the London Artizan, September, 1855.

and there is no timber to rot, and no mechanical work to do on the ground.

There are three other models—one of a bracket-joint for a double head-rail, increasing the mechanical efficiency and decreasing the cost; a second model of a similar joint for a mid-ribbed rail, to give lateral stiffness and resistance. The third is a girder rail and joint, to be applied to cross sleepers or to detached blocks. This rail is very stiff, both vertically and laterally. All these are applicable to locomotive lines.

The bridge rail and joint with the tie-bar are applied for laying down on the surface of the ground, or for cross sleepers. The rail is rolled with two lower ribs forming angles, over which the sides are drawn close by the bolts, clipping both rails and tie-bar as firmly as a vice. The rail is thus deepened vertically, and rendered stiffer. The gauge is shown as 2 feet 6 inches. The rail is adapted to lay down without sleepers on the surface of the ground, and may be easily widened by longer tie-bars. There is no timber or sleeper needed, and the rails may be moved at a moment's notice. The firmness of the joints makes the rails practically continuous bars. This rail is perfectly well adapted for horse traction, burying the joints in the ground, and leaving the rails to bear on the surface, or placing detached blocks of wood below them. The wagon-wheels are to be cast sheaves, from 15 to 18 inches in diameter, and a single spring connecting the ends of the axles together on each side. The wagons will carry a load of 30 cwt.; or a lighter rail, on the same principle, may be used to carry 15 cwt. This same rail and joint increased one-half in size, and placed on cross timbers, would make the strongest, firmest, and cheapest of ordinary lines of way. Used without sleepers, it would be found the simplest application for army and fortification lines, perfectly manageable by ordinary soldiery, and also for mineral and for agricultural lines where horses are used.

This bridge rail-joint has now been in successful use upwards of six months on one line, and is about to be laid down on four others. The bracket-joints are laying down on four lines.

Models are shown of these brackets, full size, as applicable both to joint and intermediate sleepers. Mechanically, this arrangement makes the rails much firmer, as they are lowered two inches on the sleeper; the under sides are not damaged by resting on chairs, so that they are really reversible; there are no keys to get loose, and the weight of metal is considerably reduced as compared with the chair system.

An apology may be due for the prolixity of this detail; but upon the specific question of wheels and rails depends the result of profit or loss in railway transit.

And this brings me to a very important consideration of the question at issue. Colonel Cotton compares canals as they are with railways as they are. But there is a manifest distinction. Canals, during the lapse of time from their advent to the present day, appear to have exhausted the fertility of the human mind as to their perfectibility. The only further move is to convert the external haulage of the boats to an internal propulsion. But this needs a size of canal not yet contemplated. But railroads proper have only existed 25 years, and are far from having yet attained their possible perfection. I am not going, after the fashion of

Brother Jonathan, "to draw a bill on futurity and cash it at sight;" but I appeal to any competent and unprejudiced observer who is familiar with the items on railways of "maintenance of way and rolling stock," whether reasons have not been pointed out why there is hope for a very material diminution in cost and working expenses. With this proximate and more perfect result, then, must Colonel Cotton compare the water transit he advocates. We are a "practical" people; so practical, that we have changed the very meaning of the word theorem, and made it to signify a fallacy; so that a man must forego the gift of speech, and demonstrate in materials like deaf and dumb people, ere he can gain credence. He must not set up for a critic till he is prepared with something better than the thing he criticises. For this reason only have I loaded the table with models, which seem almost an insult to common sense, as embodying the merest truisms.

There is yet another question. The canal only follows the course of all the earliest settlements, the streams, and leaves untouched the hidden wealth of the yet desert. The railway opens up mineral and other wealth. It will, if rightly used, form a line of new streets and villages. It will bring squatters from all parts to its borders, just as the opening of the Erie canal gathered together what are called "forwarding merchants" from all parts of the Union. Yet another thing. The line of the river is very commonly unhealthy by its locality. The line of the rail will, probably, be much more healthy. The very rushing of the trains sets the stagnant air in motion.

In discussing whether a canal or railway is best, the discussion must, therefore, not wander all over India, like a desultory tribe of broken men, but must be confined logically and specifically to each given river in succession. Let us know the conditions of the river as to its amount of water at all seasons—the gradients of its bed—the obstacles in its course—soil and climate, and we can deal with the question as a calculation, whether it is desirable to make a railway or not in preference to, or in conjunction with, the river. All generalizing, save as to theory, or laying down principles, is useless, when the question is one of fact, and of specific fact. It is as vague as the celebrated proposition, "Given the height of the Monument, what is the depth of the Baltic Sea?" or, to put it into an American axiom, "It is about as big as a piece of chalk."

Cotton is the staple subject. Let us know in how many localities, and of what extent, cotton grows; and, what is also very much to the purpose, in how many and what sized localities it may be made to grow along the course of the railways *in esse* and *in posse*. Whatever be the amount, there is no doubt that railways can carry it, if not on one line of rails, on two or more; with good gradients, a well-constructed engine, and wagons not damaging to the road, may transport from 100 to 150 tons net at a rate of 15 to 20 miles per hour; and 24 trains a day might follow each other in succession without casualties; in round numbers, a million and a quarter tons per annum. But in such case only one uniform rate of speed could be permitted.

But the real cost of transit on Indian railways cannot be ascertained till a mechanically perfect system shall be adopted, and the fuel procured and manufactured on the spot, and water used in the boilers distilled by

the sun, and returned in the form of rain to the Company's tanks, unimpregnated with earthy matters, that destroy the boilers and impede the production of steam. Nor can the railway be properly maintained till provision shall be made for watering the road in dry weather, as well as draining it during rain.

AMERICAN PATENTS.

List of American Patents which issued from September 4, to October 16, 1855, (inclusive,) with Exemplifications.

SEPTEMBER 4.

1. For an *Improved Machine for Electrotyping;* Joseph Alexander Adams, Brooklyn, New York.

Claim.—"The reciprocating or vibrating brush, operated as shown, or in an equivalent way, for the purpose of covering or coating the moulds, for electrotyping purposes, with any proper powdered substance; the said vibrating brush being combined, when necessary, with a carriage, arranged as shown, or in an equivalent way, so that the whole surface of the moulds may be presented gradually or successively to the action of the brush as the moulds pass underneath."

2. For an *Improvement in Mowing Machines;* Collins B. Brown, Alton, Illinois.

"The nature of my invention consists, first, in a peculiar way of attaching the finger bar to the main bar of the machine. 2d, In the peculiar construction of the frame of the machine."

Claim.—"1st, Attaching the finger bar to the bar F of the frame by means of the plates placed each side of the bars near their ends, which overlap each other, the plates being bound or pressed against the sides by the bars by means of screw bolts which pass between the two bars. The ends of the bars having screws or screw bolts passing vertically through them. 2d, Constructing the frame of the machine of two metallic sides, between which the driving wheel is placed, and attaching the bar D to the lower ends of said side pieces, and also the draft pole or tongue."

3. For an *Improvement in Supporting Ships' Topsails;* Thomas Batty, Brooklyn, New York.

"This invention consists in a novel and more effective method of supporting the top-masts and top-gallant-masts of ships and other vessels, which is particularly applicable when standing topsail-yards are employed, but, also, applicable to vessels of the usual rig."

Claim.—"The employment for the purpose of supporting or assisting to support the top-mast or top-gallant-mast and superincumbent spars and rigging, and for setting up the same when necessary, of the two diagonal double screwed iron stays, constructed and applied as described, between the cap of the lower mast and the heel of the top-mast."

4. For an *Improvement in Telegraphic Tide Gauges;* Alexander Boyd, Lumberland, New York.

Claim.—"I do not claim the employment of a float and weight for indicating the height and weight of water in channels or passages, irrespective of the mechanism herein shown, for transmitting motion to the slides, by which the lights are obscured and exposed, for they have been previously used; but what I claim is, showing and obscuring a series of lights, successively, so that the height of the water may be indicated by the number of lights visible by means of the slides provided with projections, and the rod attached to a rope or chain, said rod, operating the slides, the rope or chain working over pulleys, and moved and operated by the shaft which receives its motion by means of the float and weight."

5. For an *Improved Chimney Stack or Cap;* Mortimer M. Camp, New Haven, Conn.

Claim.—"I do not claim either of the parts as such, nor any two of them combined; but what I claim is, the combination of the three parts when constructed, arranged, and combined, as described."

6. For an *Improved Mould for Backing Electrotype Shells;* Aaron D. Farmer and Ransom Rathbone, Brooklyn, New York.

Claim.—"The use of the mould frame B, or its equivalent, in combination with the bed plate A to plate C, and clamps and handle G, or their equivalents, for the purposes substantially as described, for backing electrotype shells."

7. For a *Dovetailing Machine;* John J. Haley, Philadelphia, Pennsylvania.

Claim.—"The forming of a dovetail either as a mortise or a tennon at a single operation by angularly placed reciprocating chisels, *a a*, in combination with horizontally placed chisels *o o*, arranged substantially as set forth. I claim giving a reciprocating motion to the chisels *o o* by the snail cam or shaft, in combination with chisels, gear, and pitman rods, for the purpose of actuating the chisels in unison with each other, in the manner described. Also, the arrangement of the angular guides E E, in combination with the guide E for the purpose of effecting the under cut or sides of the dovetail. Also, the arrangement and combination of the angular guides E E and chisels *a a* on stocks F F, with the horizontal chisels *o o*, and guides *m*, and snail I on shaft H, for producing the dovetail and completing the mortise in the manner set forth."

8. For an *Improvement in Grass Harvesters;* Jonathan Haines, Pekin, Illinois.

Claim.—"I would state that adjustable seat or seats which can be adjusted have been used; but to do this, the machine must be stopped, and the adjustment, when made, is permanent; this I do not claim; but what I do claim is, first, the hanging of the cutter bar to the main frame by means of the longitudinal rods *k* and transverse rods *m*, so that said cutter bar may be free to rise and fall to the undulations of the ground, whilst it is prevented from all lateral motion. Also, the use of a driver's seat when mounted on ways or rails, so that the driver can, at pleasure, throw his weight forward or backward to aid in balancing the machine or in holding or relieving the cutters, as the variable character of the ground or condition of the grass may require."

9. For an *Improvement in Harvesters;* A. E. Kroger, Norwalk, Connecticut.

Claim.—"Attaching the finger bar D to the front bar *a* of the frame A by means of the rods which slide through the ends of the bar *a*, the rods being encompassed by springs."

10. For an *Improved Apparatus to prevent an over supply of Coal to the Fire Box of Hot Air Furnaces;* Lewis W. Leeds, Germantown, Pennsylvania.

Claim.—"The arrangement in the fire chamber of the balance valves, for the purpose of preventing an undue quantity of coal from remaining in the fire-box."

11. For an *Improvement in Consuming Escape Steam as an Adjunct in Heating Furnaces;* Thomas Maskell, Franklin, Louisiana.

Claim.—"The use of escape steam decomposed at a high heat by means of a pipe and bulb, or their equivalent, so placed above the bed of coal, as to admit of its combining readily with the gases eliminated therefrom as an economical adjunct in heating boilers."

12. For an *Improvement in Valves for Regulating Steam Engines;* Philip W. Mackenzie, Jersey City, New Jersey.

Claim.—"1st, The construction and arrangement of the cut-off valve and its seat and the disk, and the application to the said valve of a variable spring, P, or their equivalents, whereby the valve is made to cut off the supply of steam by the action of the current of steam in the passage from the boiler to the engine when it has attained the desired speed. 2d, The employment, in connexion with the cut-off valve, of the piston working in the cylinder, which is provided with a valve *d* and adjustable valve, to prevent the too sudden opening of the said valve, the said piston, cylinders, and valves operating as set forth. 3d, Providing for the opening of the cut-off valve by means of the spring as soon as the slide or other induction valve covers the part of the cylinder, by the employment of a stop to prevent the entire closing of the said valve."

13. For an *Improved Mode of Operating and Dumping Earth Cars;* Richard Ray, Louisport, Kentucky.

Claim.—"The method of operating alternate trucks upon a double railway track by the several devices, as described. Also, the automatic delivery of the loaded cars, con-

structed as described, by the several devices thereon, in combination with a post situated between the tracks. Further, the device for closing the bottoms of the cars, as described."

14. For an *Improvement in Operating Dumping Cars;* Richard Ray, Louisport, Ky.

Claim.—"The use of the guide bars when in combination with car constructed with the arm."

15. For an *Improvement in Seeding Machines;* C. and G. Stephenson, Plainfield, Massachusetts.

Claim.—"Distributing or conveying the seed from the box E to the conveying spout by means of the tube with plate attached, the tube being secured within a shaft which has a reciprocating rotary motion."

16. For a *Machine for Sawing Hoops;* Elias Strange and Thomas B. Smith, Taunton, Massachusetts.

Claim.—"The employment of two reciprocating saws, arranged as shown, viz: one saw being secured in a laterally sliding sash, and the other in a permanent sash, or one which only has a reciprocating motion in a vertical direction."

17. For an *Improvement in Grain Separators;* J. Van Horne, Magnolia, Illinois.

Claim.—"The revolving cylinder furnished with buckets, flanching, and holes, in combination with the revolving cylindrical screen, for the purpose of cleaning the grain, separating the cob, and elevating the grain, and delivering it in the manner set forth."

18. For an *Improvement in Brick Machines;* John Alexander Victor, Montgomery County, Kentucky.

Claim.—"The combination of the endless chain of moulds connected substantially as described with the two sets of rollers, one of the upper of which, in addition to aiding in drawing the mould through, at the same time compresses the clay in the mould."

19. For an *Improved Fountain Pen;* George W. White, Village of Mt. Vernon, Town of East Chester, New York.

Claim.—"The manner of constructing the holder by having two small tubes one fitting close over the other, the inner tube joined to the main band, and the outer tube having the holder for the pen attached, and having a hole drilled through both tubes on the side that the pen is attached, so that the ink may flow out into the pen, and when the outer tube is turned or revolved around on the inner tube, the holes are turned away from each other and the holder closed; this outer tube to be turned and regulated by means of a small projection on each tube to the place desired."

20. For an *Improvement in Spike Machines;* Amos Whittemore, Cambridgeport, Mass.

Claim.—"Pointing the spike by means of the inclined bed, the advancing roller, the inclined surface, and the pressing roller."

21. For an *Improved Universal Dog for Planing Machines;* Solomon S. Gray, Assignor to self and S. A. Woods, South Boston, Massachusetts.

Claim.—"1st, The arms, in combination with a pivoted clamp, whereby it is rendered rigid when desired. 2d, Placing the screw, which forces up the clamp above the level of the dogs, for the purpose set forth."

22. For an *Improved Locomotive Lamp Case;* Salmon Bidwell, Rochester, N. Y.

Claim.—"The placing of the chimney horizontally and in such a position as to discharge the smoke near the top and behind the lamp."

SEPTEMBER 11.

23. For an *Improvement in Machines for Cutting Standing Cotton Stalks;* J. W. Bocage, Cypress Hills, Arkansas.

Claim.—"The employment or use of a series of circular saws, placed upon a vertical shaft, and rotating between the bars of a metallic frame; the saws and frame being placed upon or attached to a proper carriage."

24. For an *Improvement in Lantern Guards;* C. H. Butterfield, South Lancaster, Massachusetts.

Claim.—"Making the guard movable by means of the hinges and catches."

25. For an *Improvement in Machines for Sawing Marble;* John Cochrane, Baltimore, Maryland.

Claim.—"The hanging of two saws in one gate at any required angle with each other, in combination with the angular guides, the slides, and the accommodation links, or their equivalents, for the purpose of sawing two inclined or tapering sides of a block of marble or stone at one operation."

26. For an *Improvement in the Method of Securing Keys in Connecting Rods, &c.;* George H. Coney, Boston, Massachusetts.

Claim.—"The combination of a screw nut and a screw divided longitudinally, as a means by which to hold the key in its place."

27. For a *Self-Regulating Valve for Ventilation;* John Clark, Cambridge Township, Pennsylvania.

Claim.—"The air-tight cylinder and bellows (of whatever material they may be made,) for the purpose of obtaining a motive power from the expansion and contraction of the air, and to whatever use it may be applied."

28. For an *Improvement in Machinery for Folding and Measuring Cloth;* Joseph D. Elliot, Leicester, Massachusetts.

Claim.—"1st, In connexion with the pivoted vibrating blades, the rod and swivel for causing said blades to make a half revolution during each vibration. Also, the friction bar or brake, in combination with the rolls for preventing the cloth, by the momentum of the blades, from paying off faster than it is folded."

29. For an *Improvement in Saw Mill Carriages;* Robert S. Eastham, Blanchester, O.

Claim.—"The wedge blocks worked by the rods, and springs for elevating the steadying strips up against the log for holding it steady while being sawed. Also, the combination of the catches attached to the bottom of the wedge blocks and ratchets, for holding the wedge blocks to their place after elevating the strips against the log."

30. For an *Improvement in Harvesting Machines;* John E. Heath, Geneva, Ohio.

Claim.—"1st, Suspending the reciprocating bar by means of the stirrups near the ground in front of or behind the driving wheel, in or near the same plane as the finger board, in combination with the angular friction roller. 2d, The adjustable pressure bar, in combination with the cutter teeth and fingers."

31. For a *Life-Preserving Bed for Ships;* George K. Hooper, Boston, Massachusetts.

Claim.—"My improved manufacture or life-preserving spring pontoon bed is made of a wooden frame or mattress, a series of pontoons and a series of springs arranged and connected together. Also, of making each of the pontoons of less depth at its inner edge than it is at its outer one, or that which is hinged to the frame, when the said pontoon is of such size as to project beneath the shoulder blades of a person when reposing upon the mattress."

32. For a *Charger for Fire Arms, &c.;* Josee Johnson, Washington, D. C.

Claim.—"1st, The combination of the projecting ball, cylinder, and cut-off valve. 2d, Using the clamp, in connexion with the charger, for the purpose of facilitating the rapid completion of the process of loading fire arms."

33. For an *Improvement in Hernial Trusses;* Francis Grace Mitchell, M. D., City of New York.

Claim.—"The mechanical arrangement on the back of the pad on the metal plate, which consists of a lever which presses a steel spring into a longitudinal groove formed in the centre of the metal plate on the back of the pad."

34. For an *Improvement in Hominy Machines;* Jonathan Nesbitt, Jr., and Thomas J. Cosley, Clear Spring, Maryland.

Claim.—"The construction of the beater, the same consisting in a beater provided with four faces, two of which are plane or squared, and two provided with the inclined or screw-like projections. Also, in combination with such beater, the two rows of spurs inserted in its plane faces."

35. For an *Improved Rotary Steam Engine;* Christian E. Offhaus, Newark, N. J.

Claim.—"1st, The construction of the revolving piston in rotary engines with piston

valves, said piston valves being made to open and shut by the action of the steam without any extra friction against any part on the inside of the cylinder. 2d, The arrangement of the openings and passages in the side plates, in connexion with the grooves in the cylinder, forming a communication between the inner sides of the piston valves and the steam and exhaust passages alternately. 3d, The construction of the piston valves and frames, and the manner of changing the position of the same when the motion of the engine requires to be reversed."

36. For an *Improvement in Seed Planters;* Freeman Plummer and Gilmore B. Rollins, Manchester, Indiana.

Claim.—"Links, in combination with the adjustable rods."

37. For an *Improvement in Conical Plate Railroad Car Springs;* John J. Speed, Jr., and John A. Bailey, Detroit, Michigan.

Claim.—"Providing the splitting of the edges of the disks by expansion, and effecting free unbroken compensation or lateral play for the radial elongation of the fibre or fibres when the spring is exposed to sudden or heavy compression, and ensuring equality of elasticity all round by making the disks with radial corrugations and arranging them for operation together."

38. For an *Improved Machine for Crimping Paper for Sticking Pins;* J. B. Terry, Hartford, Connecticut.

Claim.—"The use of the hinged clamps, or equivalents, operating together with the folding rod or former to crimp the paper."

39. For an *Improved Method of Operating Reciprocating Saws;* O. S. Woodcock, Connersville, Indiana.

Claim.—"Attaching the lower end of the saw directly to the upper end of the pitman by a pin which forms a joint connexion, the pitman working on a suitable fulcrum or bearing below the pin."

40. For an *Improved Construction of Beds for Shingle Machines;* Henry J. Weston, Buffalo, New York.

Claim.—"Making the yielding bed in two parts."

41. For an *Improvement in Cotton Seed Hullers;* Wm. Wilber, New Orleans, La.

Claim.—"The arrangement of the hopper, revolving toothed cylinders, breast plate, crushing and grinding cylinder, concave bed with removable extended bed plate, and toothed cylinder revolving in its toothed case. Also, the series of graduated blasts and screens for the purpose of separating the oleaginous from the other impurities of the seeds."

42. For an *Improvement in Steam Apparatus for Extracting Vegetable Oils;* Wm. Wilber, New Orleans, Louisiana.

Claim.—"A kettle for steaming or boiling and moistening oleaginous seeds, into which steam is admitted whilst it is surrounded by steam, so that the cooking and moistening be done by the direct and indirect action of steam."

43. For an *Improvement in Grinding Cotton and other Seed for their Oils;* Wm. Wilber, New Orleans, Louisiana.

Claim.—"The application of jets of steam for lubricating the surfaces of cylinders for grinding cotton seeds, to prevent their gumming up or being clogged by the ground material."

44. For a *Double Acting Force Pump;* Thomas J. DeYampert, Mobile, Alabama.

Claim.—"The system of crossed levers and connecting rods when placed and operated in the intermediate or central chamber, and when combined with two or more pistons working in cylinders which radiate from the central axis or fulcrum of said levers."

45. For an *Improvement in Horometers;* Amos Abbott, Manchester, New Hampshire.

Claim.—"An instrument upon which are delineated projections of latitude and longitude within an arc of a circle, combined with the arm and scale, or their equivalent, for the purpose of solving useful problems in spherical trigonometry without the usual

mathematical calculations. Also, the employment in mathematical instruments of magnetism, to keep a slide at right angles or any given angle to a straight edge, and at the same time allowing it to slide freely upon the straight edge."

46. For an *Improvement in Knitting Machines;* Walter and Jonas B. Aiken, Assignors to Herrick and James B. Aiken, Franklin, New Hampshire.

Claim.—"1st, The construction of the hollow circular needle plate, having grooves in its outer surface. 2d, The loop regulator."

47. For an *Improvement in Machinery for Trebling a Single Thread;* Anson A. Swift, Assignor to self and Samuel L. Hill, Florence, Massachusetts.

Claim.—"Such improved arrangement and combination of the hitching heads, movable and stationary frames, whereby I am not only enabled to dispense with an endless band and one hitching head, but employ a reciprocating frame, and thereby afford an attendant on the machine the advantage of being near the reeling mechanism."

SEPTEMBER 18.

48. For an *Improvement in Steam Gauge Cocks;* Albert Bisbee, Chelsea, Mass.

Claim.—"The arrangement of the india rubber disk or facing to the screw plug or stopper, imbedded and bound at its edges by an extension of the body of the plug, with the stationary annular stopper seat of the cock."

49. For an *Improvement in Machinery for Cleaning Cotton;* Samuel W. Brown, Lowell, Massachusetts.

"The nature of my invention consists in more effectually picking and cleaning cotton, by drawing and separating the fine dirt, dust, &c. from the cotton, by exhausting the air and dirt from above the cotton as it is thrown forwards above the secondary feed rolls, and in employing two or more sets of secondary feed rolls to conduct the cotton to the second beater in several different places."

Claim.—"1st, My within described dome, having a rack or grid in the upper portion of it, under which the cotton is thrown by the first beater in connexion with the fan in the exhaust pipe leading from the top of the dome, for exhausting the dust from the cotton as it is thrown forwards by the first beater. 2d, The use and application of two or more sets of secondary feed rolls, in connexion with the beaters, which rolls take the cotton from the dome and deliver it to the second beaters in several different places, so as to completely separate and agitate the cotton, to straighten and even the fibres, and free the dirt from it."

50. For an *Improvement in Mowing and Reaping Machines;* William Burgess, London, England; patented in England, August 16, 1854.

Claim.—"Combining the archimedean screws with the platform thereof, for the purpose of delivering the cut crop off from the same."

51. For an *Improvement in Heaters for Smoothing Irons;* Newell Cleveland and James J. Johnston, Alleghany, Pennsylvania.

Claim.—"The grated (or lattice worked) heater for box smoothing irons."

52. For an *Improvement in Feed Water Apparatus of Steam Boilers;* Joel Densmore, Blooming Valley, Pennsylvania.

Claim.—"The arrangement of the tube to enter the boiler at the water line, with the steam chest and pump cylinder, by which the steam of the boilers assists the pump worked by the engine to force water into the boiler."

53. For a *Machine for Felling Trees;* Thomas Durden, Montgomery, Alabama.

Claim.—"The employment of cutters, in combination with the feeding arrangement. Likewise, providing the jaws of the dog with a projection."

54. For an *Improvement in Corn and Cob Mills;* Rensselaer D. Granger, Philadelphia, Pennsylvania.

Claim.—"The adjustable horizontal guide rollers, in combination with the bridge tree, spindle, and spring, for the purpose of maintaining an uniform relative position of the shell with the bur, and, at the same time, allowing the former to yield from the latter."

55. For an *Improvement in Cutting Wire;* William Grover, Holyoke, Mass.

Claim.—"The use of the circular plate having radial slots formed thereon, for the purpose of holding and cutting wire, together with the gauge."

56. For *Improvements in Looms for Weaving Suspender Webbing;* Wm. V. Gee, New Haven, Connecticut.

Claim.—"1st, The method of forming button holes or other holes in suspender webbing and other fabrics, by weaving one side of the hole continuously from the weaving of the full width of the web, then running back the web the length of the hole, and proceeding with the other side of the hole. 2d, The employment for operating the harness of a sliding carriage furnished with a number of catches corresponding with the number of leaves of harness, said catches being employed below the harness opposite the lifting bars thereof, and being allowed to fall into the notches of the lifting bars of their respective leaves of harness, or being thrown out by a corresponding number of levers, which are operated upon by a pattern cylinder, or its equivalent. 3d, The method of throwing off the levers from the pattern cylinder at every stroke of the loom, to admit of the turning of the cylinder, by attaching all the said levers to a superior lever, which is operated upon by inclined surfaces upon the connecting rod of the lifting carriage. 4th, The mechanism by which the suspension of the operation of that part of the harness which carries that part of the warp which forms the side of the hole which is first woven is effected, consisting of a rock shaft, carrying catches to hold up the harness, and a finger lever attached to the lifting carriage, to act on a cam, or its equivalent, on the said rock shaft, the said finger lever having imparted to it by suitable means, a vibrating or side to side movement at the termination of the weaving of each side of the hole, to actuate the rock shaft to throw the catches in or out of operation. 5th, The method of returning the pattern cylinder to the position for commencing the pattern after the weaving of the hole, by fitting the cylinder loosely to its shaft, and furnishing the end of the shaft with a fixed slide to receive a movable slider, which is raised at intervals by a lever operated by a cam on a shaft parallel to and geared with the cylinder shaft, and at the end of the formation of the hole, suddenly falls over a step on the cam and throws down the slider, and thereby causes a fork in the cylinder, and returns it positively to the required position. 6th, Forming those dents of the reed which correspond with that part of the warp which forms that side of the button hole is to be first woven with a backward crock above or below the plane in which the closing of the sheds takes place, in order, that by raising or lowering that part of the warp of which the first woven side of the hole is composed, the said woven side may be allowed to go back the length of the hole without obstructing the lay in weaving the other side of the hole. 7th, The method of liberating the taken-up roll from the pawls, to allow the backward movement of the web, and re-engaging it with the said pawls by means of the lever, the hooked bar, the catch, and the arm. 8th, Fitting the arm loosely to the take-up shaft and engaging it, by means of a pawl, with the ratchet, and providing a fixed stop to arrest the said arm at a suitable point, whereby the take-up shaft is caused to carry the said arm the requisite distance from the catch corresponding with the length of the button hole, and then the arm to become stationary till the ratchet is liberated, and then to return with the ratchet to throw out the catch. 9th, The application, in connexion with each of the let-off rolls of a brake lever and a spring lever, the said levers operating to control the let-off, and the spring lever acting as a backward take-up to take back the web to weave the second side of the hole."

57. For an *Improvement in Brick Machines;* G. W. B. Gedney, City of New York.

Claim.—"The off-bearing boards as applied. Also, the fingers for placing the board from the mould on to the endless apron."

58. For an *Improved Sawing Mill;* Dean S. Howard, Lyonsdale, New York.

"My invention consists in the manner of setting the log forward any required distance at either or both ends of the ways, by mechanical devices operated by the weight of the log. Also, in the method of hanging and operating the saw, so as to cut from either end of the log, the same way of the grain, the axis of the saw being above the log when cutting from one end, and beneath it when cutting from the other."

Claim.—"The method of setting the log forward after each board is severed, by mechanical devices operated by the weight of the log. 2d, The method of cutting from either end of the log with a circular saw, by hanging the saw in a vibrating frame, or its equivalent, so that the axis of the saw may be above the log when cutting from one

end, and beneath it when cutting from the other end, so as to cut either way against the grain of the wood. Also, the self-setting arrangement, whether in connexion with the circular saw or the single or double edged reciprocating saw, as equally applicable to either."

59. For a *Dovetail Key Cutter;* Amos P. Hughes, Philadelphia, Pennsylvania.

Claim.—"The combination of two angular V shaped and adjustable cutters with the guiding tube, or its equivalent."

60. For an *Improved Plane Bit;* Horace Harris, Gorham, New York.

Claim.—"The adjustment of the cap and bit with the grooves at each side, and of the thumb screw at the top of the cap and bit for the regulation of the cut of the bit, while the iron is held fast in the stock by the wedge fastening."

61. For an *Improved Card Printing Press;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"The combination of the connected chambers of the platen with the spring driver of the bed, for the automatic feed and delivery of cards."

62. For an *Improvement in Lanterns for Locomotives;* James H. Kelley, Rochester, New York; ante-dated June 30, 1855.

Claim.—"The construction of locomotive lamp cases with vertical descending flues open at bottom only."

63. For an *Improvement in Machinery for Picking Fibrous Materials;* Richard Kitson, Lowell, Massachusetts.

Claim.—"Casting or forming the notched plate with locking pieces, for the purpose of entering between the prongs of the teeth into the grooves, which are formed in the cylinder to receive the teeth, and fitting down to the bottom parts or crotches of the teeth, and thus securing them in place."

64. For an *Improved Seal and Stamping Press;* Edmund Morris, Trenton, N. J.

Claim.—"Causing of the frame, which contains the die or plate, to work to and fro on a joint or hinge, so that the latter may be turned over with its face upward in a convenient position to receive a supply of ink."

65. For *Piano Forte Action;* John S. Morton, City of New York.

Claim.—"The arrangement and operation of the lever pivoted to the jack, post, or cushion, and block, with the jack and hammer, to effect the repeat, and whereby, while the use of an additional spring or weight is dispensed with, the weight of the hammer operating on the lever returns the jack to its notch in a position under the butt."

66. For an *Improvement in Fire Arms;* William W. Marston, City of New York.

Claim.—"1st, Elevating the hammer to cock and discharge the piece by means of a cam revolving with the barrels or chambers, and formed with as many points as there are barrels or chambers, so that the hammer shall be raised and discharged by simply rotating said barrels or chambers. 2d, The revolving face plate formed with projections on its face to take the seer, and with notches on its edge taking the stop on the trigger, the two acting to rotate and stop the barrels at the precise point required, and prevent the strain on the trigger from turning the barrels too far. 3d, The mode of constructing and fitting the parts of the cam, face plate, trigger, seer, and stop, so that the hammer shall be cocked by one, two, or more pulls on the trigger, and then discharged by another slight pull of the trigger."

67. For an *Improvement in Revolving Fire Arms;* Frederick Newbury, Albany, N. Y.

Claim.—"The method of operating an oblique toothed ratchet wheel by the direct action of the upper limb or cam end of the trigger, which trigger, also, by the same action, cocks and discharges the hammer and holds the cylinder firmly in place during the firing of the piece. Also, the employment and use of a slot in the trigger for the traverse of its centre pin or axis, in combination with the action of the trigger directly upon the hammer, in order to enable the trigger to replace itself behind the hammer as before the discharge of the same. Also, the apparatus for attaching and detaching the barrel to the stock, to wit, the catch lever lying in the stock underneath the cylinder, with its hook, and finger piece, and spring, together with the recess and stop in the block."

68. For an *Improvement in Safety Apparatus for Steam Boilers;* John M. Reeder, Nashville, Tennessee.

Claim.—"Connecting the valve stems, so that the valve may be raised by hand from the outside to flood the fires, but cannot be weighted from the outside to increase the steam over a given quantity."

69. For an *Improved Instrument for Determining Latitude and Longitude;* John Stinson, Danville, New Jersey.

Claim.—"The use of the circle with its shaft or handle provided with the cross piece G and the cross piece, H or their equivalent, the whole being suspended from, at, or near the centre of the circle by means of the plumb wire and rod, which rod is jointed, so as to move freely in a plane passing through the axis of the circle."

70. For an *Improvement in Cooling Cast Iron Car Wheels;* John M. Sigourney, Watertown, New York.

Claim.—"The arrangement of the mould, chill, and ring, for equalizing the cooling of the car wheel."

71. For an *Improvement in Knitting Machines;* Clark Tompkins and John Johnson, Troy, New York.

Claim.—"1st, The manner in which we cause the frame which carries the take-up mechanism to revolve in the same direction and with the same velocity as the needle cylinder. 2d, Combining the web shaping plates with the take-up mechanism."

72. For a *Preparation of Metallic Plates for Printers;* Samuel W. Lowe, Philadelphia, Assignor to self and Jacob M. Beck, Harrisburgh, Pennsylvania.

Claim.—"Coating the plain or unengraved face or surface of the plate (which is intended for leaving the white or unprinted surface of the paper) with a mercurial amalgam, that will have the effect of preventing the ink used in printing therefrom from adhering to or soiling the same, whilst the figures engraved or etched thereon readily receive the ink, and thus admit of printing from the plate in the same "form" with the type, without the "wiping" heretofore required in printing from steel or copper plates. Also, the coating the plane surface of etched or engraved steel plates with an alloy of tin and mercury; and also, the coating of etched or engraved copper plates in the same manner and for the same purposes; and the coating of the plane surface of metallic embossing plates in the same manner, and for the more special purpose of using the sunken parts when filled up with a resinous substance as a plate to print from, thus saving an extra color plate when it is desired to have the parts to be embossed first printed in any color."

73. For an *Improvement in Curtain Fixtures;* Peter H. Niles, Boston, Assignor to Ralph C. Webster, Watertown, Massachusetts; ante-dated March, 18, 1855.

Claim.—"The combination of the bracket, having a hole of double diameter with the spring pin and the roller end, either with or without a spool thereon, fitted to correspond to said hole, and dispensing with the knob or cap on the other end of the roller."

74. For an *Improvement in Cooking Stoves;* John Van, St. Louis, Missouri.

Claim.—"The arrangement of the water cylinder with separate chambers, fire cylinder or space in its centre opening through its top, and cross and heating tubes combined."

SEPTEMBER 25.

75. For an *Improved Apparatus for discharging Reservoirs, &c.;* Daniel Bedford, City of New York.

Claim.—"The mode of hanging and balancing the valve, by means of the lever and its appurtenances. Also, in combination therewith, the float for closing the valve, when the whole contents of the receptacle are discharged."

76. For an *Improvement in Machines for Sawing Stone;* C. G. Bietel and H. J. Brunner, Nazareth, Pennsylvania.

Claim.—"The combination of the flexible saws, rollers, adjustable radial ways, and concentric grooves or ways, whereby the saws are enabled to run at different angles, and their open ends to approach and separate, without affecting the degree of their tension."

77. For an *Improvement in Fire Arms;* Frederick Beerstecher, Philadelphia, Pa.

Claim.—"Constructing the head of the hammer of fire arms of this description, so that the part of the head which discharges the forward load, shall be capable of being turned down, for the purpose of allowing the shorter part of the head to strike the rear tube only; and so, that when turned up, it shall strike the forward tube only, without the use of the intermediate covering lever heretofore required, for the purpose of preventing the explosion of the rear cap, in fire arms of this description."

78. For an *Improvement in Pressure Stoppers for Chain Cables;* James Emerson, Worcester, Massachusetts.

Claim.—"The arrangement of the jaw, hinged at its one end, and having a pawl at or near the other, with the bed plate, for operation together."

79. For an *Improved Method of Regulating Length of Stroke in Mortising Machines;* Ezra Gould, Newark, New Jersey.

Claim.—"Attaching the connecting rod to a curved slotted arm, by means of the plate and pin; the plate working in the slot in the pulley and the arm, operated by means of the gearing."

80. For an *Improvement in Coffee Pots;* Joshua E. Hall, Cleveland, Ohio.

Claim.—"The conical tube, with the knob and aperture, which serve as its continuation; this I claim in combination with the reservoir."

81. For an *Improvement in Rakes for Reaping Machines;* Thomas N. Lupton, Winchester, Virginia.

Claim.—"The construction of an automatic rake, having a revolving tubular or sleeve socket, with a revolving extension, or reciprocating piston rod, a slide socket with a sliding arm, and a geared rake device, in combination with the collar."

82. For an *Improvement in Wrench;* Henry J. Behrens, City of New York.

Claim—"The employment of an eccentric toothed on its periphery, and held down by a spring, in combination with the smooth bar wrench."

83. For an *Improved Method of Actuating Gas Engines;* William Mt. Storm, City of New York.

Claim.—"Operating an engine by the agency of water, charged with a gas permanently uniform at ordinary atmospheric temperatures and pressures, and over which water has a self-acting power of absorption, when the process consists in passing a given quantity of the gas set free in charges, under pressure by heat through the engine actuating its piston, and thence to a closed cool and wet vessel, while contemporaneously therewith, I cause to pass to said vessel a sufficient quantity of the same water which had just previously held the gas absorbed to re-absorb it; both water and gas being cooled meanwhile, by means specially provided, to an extent sufficient to cause their re-combination in the original form of gas-charged water, by all of which means the motive power of the gas is obtained, without the necessity of converting the water into steam, while at the same time the gas is thereby re-concentrated and preserved for re-use without entailing an accumulation of water in the heating or separating vessel, or an accumulating pressure of free gas in the cold receiver."

84. For an *Improvement in Corrugated Beams;* Richard Montgomery, City of New York.

Claim.—"A supporting beam formed of sheet metal of unequal thickness, bent into a series of folds."

85. For an *Improved Awning for Horse and Dray;* Jacob Nelson, Cincinnati, Ohio.

Claim.—"The portable and reversible dray and horse canopy, whose poles are hinged at one end to posts, and supported in either the forward or backward position, by branches or brackets projecting from the posts."

86. For an *Improvement in Ships' Rudders;* John S. Robbins, San Francisco, Cal.

Claim.—"Arranging the two rudders and combining them by means of arms and connecting rods."

87. For an *Improved Machine for Cutting Ornamental Mouldings;* H. and Richard S. Schevenell, Athens, Georgia.

Claim.—"The combination of the reciprocating gate or slide, rotary patterns, and the inclined planes or wedges."

88. For an *Improvement in Optical Instruments;* Robert B. Tolles, Canastota, N. Y

Claim.—"Constructing the eye piece in such a manner, that when placed at a proper distance within the focus of an object glass, its anterior refraction shall be properly that of a concave lens."

89. For an *Improved Hold Back for Carriages;* Alonzo Webster, Montpelier, Vt.

Claim.—"The dovetail groove, the dovetail slide, and the spring."

90. For an *Improvement in Leather Finishing Machines;* Charles Weston, T. F. Weston, and John W. Weston, Salem, Massachusetts.

Claim.—"A machine for finishing leather, in combination with the soft elastic bed and elastic finishing tool, the cord secured to the tool stock, for the purpose of keeping the tool clear of the leather, during its retrograde movement over the bed."

91. For an *Improved Boring Machine;* A. Wyckoff and E. R. Morrison, Elmira, N. Y.

Claim.—"1st, The employment or use of the tubular or hollow auger. 2d, The combination of the tubular or hollow auger and worm or screw."

92. For an *Improvement in Bedsteads;* William White, Portsmouth, Virginia.

Claim.—"The jointed parallelogram of bars provided with rods, or their equivalents, which extend to the bedstead at several points and are secured thereto and tightened."

93. For an *Improvement in Trip Hammers;* Peter L. Weimer, Reading, Pa.

Claim.—"The arrangement of the hub or centre piece, the pawls, the interior ratchet ring, the lined metallic strap, the hand wheel, and the post."

94. For a *Machine for Making Printers' Types;* Samuel S. Weed, Stoneham, Mass.

Claim.—"The combination and arrangement of the stationary body or bed die, the bottoming die, and receiving orifice. Also, the combination of the feeding lever, the nipper, and the rod provided with shoulders, the whole being for the purpose of feeding the type rod into the mechanism, or its dies."

95. For an *Improvement in Flouring Mills;* D. S. Wagener, Penn Yan, N. Y.

Claim.—"The arrangement of tubes, connected by the supplemental shoe within the air-tight chamber."

96. For an *Improvement in Artificial Legs;* John Taggart, Roxbury, Mass., Assignor to self and Theodore Parker, Boston, Mass.

Claim.—"Making the leg and foot without any ankle joint. Also, combining together and with the foot, the part and the thigh case, the two springs, so as to operate therewith."

97. For an *Improvement in Ships' Windlasses;* John B. Holmes, Assignor to self and John R. Pratt, City of New York.

Claim.—"The arrangement of the shaft, with its gearing wheels and clutch coupling, in relation to the drums of the windlass, and their gearing, whereby the one or both drums may be moved with a quick or with a slow motion; or the one drum may be moved with the quick, and the other with the slow motion, at the same time."

Re-Issues for September, 1855.

1. For an *Improvement in Air-Heating Stoves;* J. M. Thatcher, Jersey City, N. J.; patent dated March 23, 1852; re-issue dated Sept. 11, 1855.

Claim.—"Making the bottom plates of the flue spaces of air heating furnaces or stoves, for the passage of the products of combustion outward or inward, among or around the air passages, inclining inward and downward, toward the fire chamber, for the purpose of facilitating the increase of the heating surface, without the inconvenience of the accumulation of ashes, soot, and other solid matter on such plates. Also, the combination of the inverted domes or frustrums and plate, with the short tubes connecting them, for the purpose of effecting the connexion between the lower ends of the fire or draft flues, and carrying the air through them, to the spaces between the cylinders or tubes."

2. For an *Improvement in Grain Dryers;* John Massey, City of New York.; patent dated April 17, 1849; re-issue dated Sept. 11, 1855.

Claim.—"In the method of kiln drying grain, the employment of an endless pan, or apron, made of metal, and passing around drums, or the equivalents thereof, in combination with, and operated within, a heating chamber."

3. For an *Improvement in Pumps;* Levi P. and William F. Dodge, Newburg, N. Y.; patent dated June 7, 1853; re-issue dated Sept. 25, 1855.

Claim.—"The combination of the cylinder or chamber and the piston with its valves and the induction and eduction passages, so that the water all entering said cylinder, under pressure alternately at its ends, is discharged under pressure through the opening at its side, producing a constant and direct stream through the piston heads from the cylinder; thus dispensing with chambers and partitions in the barrel and valves at the eduction port, preventing leakage, and rendering the pump more simple and effective, and less liable to derangement."

DESIGNS FOR SEPTEMBER, 1855.

1. For *Trade Marks;* Thomas Lewis, Malden, Massachusetts; dated Sept. 4, 1855.

Claim.—"The ornamental design or trade mark, to be fixed on articles of manufacture and formed without the padlock."

2. For *Cooking Stoves;* William T. Coggeshall, Fall River, Massachusetts; dated Sept. 4, 1855.

Claim.—"The ornamental configuration of the base, cornice, and edge of the main hearth, constitutes one feature; so, in regard, not only to the peculiar base relief star ornament, or collection of rays applied to each of the lesser doors, but to that figured on the main oven door. The bas-relief upon each foot, is also a part of the design; the whole combined with the mouldings and panels constituting the design."

3. For *Table Castors;* Edward Gleason, Dorchester, Mass.; dated Sept. 11, 1855.

Claim.—"The wreath on the circular projection, and the embellishments on the doors and feet."

4. For *Parlor Grates;* James Andrews, Assignor to Andrews & Dixon, Philadelphia; dated Sept. 11, 1855.

Claim.—"The design for parlor grates."

5. For *Stoves;* James H. Conklin, Peekskill, N. Y., Assignor to Samuel B. Sexton, Baltimore, Maryland; dated Sept. 11, 1855.

Claim.—"The design, configuration, and arrangement of the ornaments in bas-relief on stove plates."

6. For *Ovens of Cooking Stoves;* George W. Chambers, Troy, N. York., Assignor to Peter A. Palmer, Leroy, New York; dated Sept. 18, 1855.

Claim.—"The ornamental design and configuration of the side and end plates of an elevated oven of a cook stove."

7. For *Cast Iron Monuments;* J. H. Wilson, Chesterfield, Ill.; dated Sept. 18, 1855.

Claim.—"A design for a cast iron monument for the head of graves, combining the figures of the harp and heart, with a recess for the insertion of a miniature likeness and inscription, and a locket for hair."

OCTOBER 2.

1. For an *Improvement in Preparing Materials for Hat Bodies;* Peter Arneson, Jorgen Pederson, and Hans Rees, City of New York.

Claim.—"1st, The combination with a feed box having adjustable partitions therein, so that the material to be used may be proportioned in quantity, in its different apartments the machinery for taking it therefrom, and thoroughly mixing it in said proportions, preparatory to its being used in hat bodies. 2d, The combination of the two cylinders and plate, the cylinders having serrated plates attached to its periphery, and the plate provided with a serrated edge. 3d, The combination of the box, provided with the

endless apron, the shell, and conical head, with the wings or blades at its end, whereby the materials are thoroughly mixed, and discharged from the machine in a loose and light state, and may be delivered without any handling to the next machine."

2. For an *Improvement in Machinery for Manufacturing Hat Bodies;* Peter Arneson, Jorgen Pederson, and Hans Rees, City of New York.

Claim.—"1st The combination of the endless aprons, cylinders and plate, and brush cylinder, for the purpose of feeding the material in a proper state, to the series of cylinders and the formers. 2d, The weighing apparatus, formed of the levers, ring, and weight, when the weighing apparatus is so arranged, that the former while in motion, and the fur is being thrown upon it, may rest upon the weighing apparatus, and the former exhaust and fur, by their weight counter-balance or raise the weight, when the proper quantity of fur has been thrown upon the frame, to form a hat body. 3d, The guides or conductors, constructed of india-rubber, and provided with the adjustable frames at their outer ends, said frames being provided with set screws. 4th, The employment or use of the slide or cut-off, and the movable bed-piece or platform, for the purpose of regulating the blast, and stopping the supply of fur to the former."

3. For an *Improvement in Corrugated Reflectors;* Bernard Goetz, Philadelphia, Pa.

Claim.—"A reflector having the peculiar form of grooved or fluted undulating surface, and the converging grooves, and crossed transversely, by the other series of parallel grooves."

4. For an *Improvement in Sewing Machines;* James Harrison, Jr., Milwaukie, Wis.

"This invention relates to that description of sewing machines, in which the seam is formed by the interlacing of two threads, which are carried through the material to be sewed, from opposite sides thereof, in the form of loops, by two needles arranged obliquely to the material, and operating by turns, each to pass its loop through the loop previously passed through the material by the other; such machine being generally known as the 'Avery sewing machine.'"

Claim.—"1st, In combination with the giving of the two needles, such a movement as will cause both at once during every revolution or stroke of the machine, to be withdrawn from the cloth, for a sufficient time to effect the feed movement, the employment of a supplementary needle, to supply the place of the needle which operates first after the feed movement, and to retain the loop in the thread, which has been put through the cloth by the needle which last leaves the cloth, before the feed movement, until the first named needle operates to pass through the said loop. 2d, The attachment of the clamps which hold the material to be sewed, to two swinging guide plates, or their equivalents, which serve also as guide plates to the needle bars, and thereby cause the needles and the clamps to swing together, whereby the clamps are enabled to accommodate themselves to different or varying thicknesses of material, and to be opened to slacken their hold upon the material, during the feed movement, and the needles are enabled to be kept in a proper or desirable relation to the clamp. 3d, The connexion of the two swinging guide plates, or their equivalents, whereby one of them is caused to have a movement so much greater than the other, that the relative movements of the needles and clamps shall be such, that the needles in all positions of the clamps will cross each other in the plane of, or as near as is desired, to the plane of the face of one of the clamps which is the plane of one surface of the material."

5. For an *Improvement in Screw Wrenches;* Joseph Hyde, City of New York.

Claim.—"The eccentric shaft and thumb piece, as they are arranged in relation to the screw of the movable jar, so that the screw may be thrown in and out of gear with the bar, and the jaw be moved, by sliding it on the bar, or through the turning of the screw."

6. For an *Improved Feed Motion for Planing Machines;* Seth C. and Westel W. Hurlbut, Bloomville, New York.

Claim.—"The application of the worm wheels, in connexion with the spur wheels attached to the shafts of the feed rollers, to effect their proper revolution, and to admit of their opening apart, to receive various thicknesses of lumber."

7. For an *Improvement in Steam Boilers;* Charles Moore, Trenton, New Jersey.

Claim.—"1st, Limiting the circulation of the water in a steam boiler, by means of a partition, so constructed as to separate the fire over the water, or some portion of it, or

the water which is highly heated, or that which ascends through the tubes, from mixing with the water around the sides of the boiler, which is at a lower temperature, and thereby preventing it from descending, so as to enter the tubes again at the lower ends. 2d, So constructing and arranging the tubes in the fire space, that the burning fuel will surround the horizontal parts of the tube, and a portion of the perpendicular parts. 3d, Extending the tubes downwards, which pass through the fire space, after they leave said space, and terminating their perpendicularly in the water space, so as to prevent or retard the water, which is highly heated, or the steam generated in the tubes from escapeing from the lower ends."

8. For an *Improved Chimney Stack;* Benjamin F. Miller, City of New York.

Claim.—"Constructing and placing a solid or hollow cone, or a pyramid, in the mouth of the funnel or smoke stack, with its apex upwards, or pointing outwards from the mouth of said chimney or pipe, in combination with the surrounding shield, furnished with flanches."

9. For an *Improvement in Knitting Machines;* Joseph Powell, Waterbury, Conn.

Claim.—"1st, So combining two sets of needles, such as are commonly employed on knitting frames, that they may be brought into joint action, and have loops formed on both of said sets, at one and the same time, and thus form a ribbed fabric. 2d, The arrangement of the needle bars and the two pressure bars, so combined, that when both sets of needles are in action, both pressure bars will also act upon the barbs of the needles. 3d, The self-setting latches, in combination with the needle and pressure bars. 4th, The combination of the regulating bar with the shifting bar and the set screw, for regulating the throw of the sinkers and depth of the loops. 5th, The manner of discharging the loops, that is to say, casting off those of one set of needles, a little in advance of those of the other set, and giving to the first set of needles an upward motion, as soon as the cast-off has been effected from them, for the purpose of relieving the strain."

10. For an *Improvement in Ships' Pumps;* Samuel Pearn, City of New York.

Claim.—"The combination of the two series of oppositely inclined conical pipes, when the small ends of the pipes of one series are inserted and project within the body of the pipes of the other series, and vice versa, with sufficient space around the inserted ends, for the return of the water, as the apparatus is vibrated alternately in opposite directions."

11. For a *Clock Escapement;* E. K. Reynolds, City of New York.

Claim.—"Constructing the staff of the balance, with a spiral groove, and so arranging the balance, that the point of the lever will work in the said groove, and give the requisite motion to the balance."

12. For an *Apparatus for Opening and Closing Hatchways;* Henry Sizer, City of New York, and Elisha Stone, Lowell, Massachusetts.

Claim.—"1st, The chain wheel, the chain, the rack, the doors with segments of gears or whole gears attached to them, and the gear for the purpose of opening and closing hatchways or scuttle doors. 2d, The parts before mentioned, either or all of them, in combination with the cylinder, the rope wheel, and the gears, for the purpose of opening and closing the doors of scuttles or hatchways."

13. For an *Improvement in Moulding Circular and Undercut Work;* William Sellers and James Walker, Cincinnati, Ohio.

Claim.—"The method of moulding circular undercut work."

14. For a *Coopers' Crozing-Plane;* Hiram and John C. Taylor, Cincinnati, Ohio.

Claim.—"Casting the stock in one piece, and combining therewith a wedge."

15. For a *Machine for Preparing Rattans, &c.;* Charles C. Reed, Assignor to self and William S. Reinert, Philadelphia, Pennsylvania.

Claim.—"1st, The construction of the adjustable table or plate, with the upright feeding and guide rollers, for enabling the upper surface of said table or plate to be graduated to the grooves in the rollers. 2d, Arranging the adjustable side bars, in such relation to the upper and lower parts of the flexible portions of the springs, as to enable them to be graduated, so as to arrest the outward movement of the lower flexible portions of said springs, at such points as to allow the rollers to yield sufficiently to receive and embrace the rattan between them, and yet prevent one of them from moving further from the centre than the other, so as to keep the rattan, at all times, in the centre groove,

and at the same time, allow a slight and stiff elastic movement to the upper portions of the springs above the bars, to allow either of the rollers to yield to the inequalities on either side of the rattan."

16. For a *Thermo-Udoric Filter;* Gustavus Weissenborn, Assignor to Epes W. Sargent, City of New York; patented in England, Nov. 17, 1854.

Claim.—"The method of separating impurities or mineral substances from water, by so introducing steam and water into a suitable apparatus, that they shall commingle, and the water thereby be heated, to fall in a shower upon, or be brought in contact with, pebble stones, twigs, bushwood, or other suitable substances or surfaces, whereon said mineral matter or impurities will be deposited."

17. For an *Improvement in Machinery for filling Seine Needles;* Humphrey M. Glines, Assignor to John M. and Simon F. Stanton, Manchester, N. H.

Claim.—"Giving the needle a rotary motion around its own centre, both horizontally and transversely, by means of devices described, or their equivalents, in combination with a vibrating delivering arm, or its equivalent, so constructed, arranged, and operated, as to supply and deliver the twine or other material to the aforesaid needle."

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18. For an *Improvement in Sewing Machines;* C. J. Cowperthwaite, Philadelphia, Pa.

Claim.—"The weighted trip lever, applied to the bar, or its equivalent, which holds the cloth, so as to serve not only to apply pressure to the cloth, but to hold up the said bar, or equivalent, from the cloth when desired; also, to allow the said bar, or equivalent, when its foot is struck by the needle bar, while it is held up, to descend and to hold it down again, until it is lifted by the operator. 2d, Arranging the shuttle race obliquely to the direction in which the cloth is moved, to produce the seam, or line of sewing, for the purpose of causing the visible parts of the stitches on the front or upper side of the cloth to be straight, or all in the same line."

19. For a *Machine for Gauging, Measuring, &c., Staves;* Larkin T. Atkins, Page County, Virginia.

Claim.—"The combination of treadles, clamps, and vibratory arms or levers, operating as set forth."

20. For an *Improvement in the Manufacture of Acid Sulphite of Limes;* Phillippe L' Bernard and Joseph Albrecht, New Orleans, La.

Claim.—"The apparatus for the manufacture of sulphite and bi-(or acid) sulphite of lime, consisting of the oven, the three superposed cylinders, and the ventilator."

21. For an *Improvement in the Manufacture of Borax, from Native Borate of Lime;* Thomas Bell and Henry Scholefield, South Shields, England; patented in England, July 25, 1854.

Claim.—"Our mode of manufacturing borate of soda from borate of lime, the same consisting in boiling the borate of lime in water, and an acid separating the lime and other foreign matters, adding a saturated solution of soda to the liquid, boiling the compound, separating the impurities or foreign matters therefrom, and subsequently evaporating the clear liquor, and crystallizing out the borax therefrom."

22. For an *Improvement in Corn Shellers;* Charles Bishop, Norwalk, Ohio.

Claim.—"In combination with a shelling disk or wheel, the series of ear boxes, radially arranged around it, said boxes being composed of elastic backs and unyielding partitions."

23. For an *Improvement in Washing Machines;* John A. Bills, Troy, N. Y.

Claim.—"The movable partitions."

24. For an *Improvement in Preparing Vegetable Fibre;* Jean Blanc, New Orleans, Louisiana.

Claim.—"The staking of the plants buts down, in a pit dug for said purpose, and surrounding them with dry leaves or straw, with earth thrown around the same, thereby enclosing them entirely on all sides, leaving the top open and uncovered."

25. For an *Improvement in Cut-off Valves for Oscillating Engines;* Henry E. Canfield, City of New York.

Claim.—"The arrangement in oscillating engines of separate loose valves, moving independently of each other, when the motion is given them by the oscillation of the cylinder, for the purpose of cutting off the steam, at such part of the stroke as may be desired."

26. For an *Improvement in Churns;* John G. Dungan, Steubenville, Ohio.

Claim.—"Giving the outer leaves of an alternately opposite rotating agitator, a rocking motion, to and from the sides of the churn."

27. For an *Improved Apparatus for Heating Buildings by Steam;* Charles Davenporte, Watertown, Massachusetts.

Claim.—"The arrangement of the vessel, and its connecting pipes and valve, the supply cistern, the boiler, the radiator, and the leading steam and return pipes of the said boiler and radiator."

28. For an *Improvement in Corn Shellers;* Stephen Elliot, Wayne County, Indiana.

Claim.—"The combination of the screws, with the clamping jaws."

29. For an *Improvement in Cotton Gins;* H. H. Fultz, Lexington, Miss.

Claim.—"Giving the cotton to be ginned, within the feed box and directly over the saws, a spiral or twisting motion, by means of the plates or an equivalent device, so that the cotton will pass from one end of the feed box to the other, and have a fresh surface presented successively to the action of the saws as it passes over them."

30. For a *Wind Regulator for Organ Pipes;* Daniel George, Nazareth, Pa.

Claim.—"Constructing the lower part of each or any of the pipes of an organ with a traverse seat, fitted with a plug, like that of a faucet, having a suitable passage or passages, the area of which is regulated by turning the plug, for the purpose of regulating the tone of the tube and tuning the instrument."

31. For an *Improvement in Vibrating Pumps;* Ellwood Garrette, Wilmington, Del.

Claim.—"The arrangement of the side passage, with its openings into chambers respectively, in combination with the vibrating pistons, having their valves opening upwards, or in the direction of the outlet of the water."

32. For an *Improvement in Grain Separators;* Peter Geiser, Smithsburg, Md.

Claim.—"The vanes within the fan case, against which the blast acts, for the purpose of closing or opening the register, automatically, to regulate the blast. Also, the manner of separating the grain from the straw and other impurities, by means of the aprons, vents, and grooved rolls, without the use of a riddle, whether one, two, or more sets of such separating apparatus be used. Also, in combination with the separating apparatus, the self regulating dividing shelf, upon which the grain drops, for the purpose of carrying the heavy grain back, and the lighter forward; for a second or more complete separation. Also, the hinging of the upper to the lower portion of the straw carrier frame, and providing it with adjustable slides or conveyors, for dividing and conveying the straw into any desired localities."

33. For an *Improved Amalgamator;* Samuel Gardiner, Jr., City of New York.

Claim.—"1st, The the hollow perforated rollers, receiving water at their journals, and discharging it in small streams all over their peripheries, and revolving in opposite directions in a trough or troughs of quicksilver, so that their upper parts are constantly approaching each other, and having the auriferous and other metaliferous matter fed above or between them. 2d, The employment of the amalgamating rollers and the distributing rollers and trough, whereby the matter is fed equally, on both amalgating rollers, and on the descending portion thereof."

34. For an *Improvement in Portable Boring Engines;* Thomas Goodrum, Providence, Rhode Island.

Claim.—"1st, Conducting the steam to the engine through a pipe, which is fitted to slide within another pipe, whereby the weight of the engine may be supported by the pressure of the steam. 2d, The employment of two or more sliding pipes of different sizes, one within the other, in combination with suitable clamps, for the purpose of securing

all but such one of the said pipes, whose area acted upon by the working pressure of steam, will receive an aggregate pressure, about equal to the weight of the engine."

35. For a *Machine for Making Envelopes, &c.;* E. W. Goodale, Clinton, Mass.

Claim.—"1st, The employment in a machine for making envelopes or bags, to support the blanks during either or all of the operations of pasting, stamping, and applying the gluten of a self-adjusting table, supported by a cam, whose position is so controlled, by a spring, or its equivalent, applied to its shaft, that as the blanks are removed, one by one, the table is caused to rise, to bring the next one to the proper height or position, to be pasted, stamped, or have the gluten applied. 2d, Giving the self-adjusting table a drop movement, by means of the cam, the lever, pawls, ratchet wheel, or their equivalents, acting on the shaft of the supporting cam. 3d, Applying the gluten which makes the envelope or bag, self-sealing to that part of the blank which is to form the seal flap or closing flap of the envelope or bag by a die, while in the machine at the commencement of the process, whereby the said die serves the two purposes of applying the gluten and of lifting the blanks one at a time, from the pile, or retaining the top one, while the remainder of the pile is lowered away from it. 4th, Applying the two dies to two arms, or jaws, which are connected together by a hinge, or its equivalent, arranged at the rear of the table, and have a sliding motion, back and forth, to move the said dies out of the way of every successive blank, till the latter has had the gluten applied and been separated from the pile, and then to bring them forward again, to receive the separated blank and to receive the pressure of the screw, or its equivalent. 5th, Attaching the paste box, the gluten die and the screw, or other equivalent device, which gives pressure to the stamp, which produces the seal to a head, receiving such a motion as described from a pair of cranks, or their equivalent. 6th, The employment of a pair of nippers, having a motion of a positive length, in the line parallel with the line in which the blank is required to move, from the pasting to the folding apparatus, either to take a cut blank from a table, or to draw the material before it is cut, from a roll, and measure off the proper length to be cut. 7th, The method of giving the necessary movement to the lappers, by means of the bent levers and the springs applied to their hinges. 8th, The creasing fingers, to hold the blank in position, and crease it in the line for holding the seal flap. 9th, The nippers arranged and operating in a lateral direction, to remove the finished envelopes or bags, at one side of the folding stand. 10th, The lifter, applied to the folding stand, and operated by the lever which carries the nippers, for the purpose of lifting the finished envelope or bag, at one side thereof, from the stand, to enable it to be taken by the nippers. 11th, Applying a stamp to work through the table, for the purpose of stamping a card, or other on a bag, during the process of manufacture. 12th, The general arrangement and combination of the several working parts of the machine."

36. For an *Improvement in the Variable Exhaust of Locomotive Engines;* Samuel L. Hay, Reading, Massachusetts.

Claim.—"The application of a self-regulating and adjustable blast pipe, to a locomotive engine."

37. For an *Improved Fish-Hook;* Job Johnson, Brooklyn, New York.

Claim.—"The method of catching fish, by means of a cluster or spider of hooks, beneath and around suitable bait, so that said hooks can be suddenly raised up, and catch the fish, while nibbling at the bait. Also, the method of attaching and hanging the hooks, from the ends of the spider arms, by means of the spring throat, whereby said hooks can be varied or replenished."

38. For an *Improvement in Apparatus for Washing and Bleaching Fibrous and Textile Substances;* Julius A. Jillson, of Poughkeepsie, N. Y., and Henry Whinfield, City of New York.

Claim.—"Combining with the washing, extracting, or receiving chamber, the double acting force pump, and the disinfecting or bleaching vessel."

39. For a *Machine for Making Wire Dish Covers;* William Lincoln, Oakham, Mass.

Claim.—"The combination of rotary forming and holding dies, with beading mechanism applied to operate therewith. Also, the guide spindle, in combination with the cup die and follower. Also, the carriage, the guide, the gearing and shaft, as combined with the dies and the beading mechanism. Also, combining with the cup die, the movable gauge top."

40. For an *Improvement in Economizing Steam;* George M. Longacre, New Orleans, Louisiana.

Claim.—"The employment of two sets of boilers, having steam of different pressure and temperature therein, and passing the steam from the boiler of the highest pressure through the pipes of the evaporators, &c., to the other boiler, from whence it is used to move the machinery of the mill."

41. For an *Improvement in Ploughs;* Harrison Norton, Farmingham, Maine.

Claim.—"Attaching the share to the mould board and "land side" of the plough, by a hinge or joint, and moving said share by means of the bar and lever, or their equivalents."

42. For an *Improvement in Radiators of Steam Heating Apparatus;* A. S. Pelton, Clinton, Connecticut.

Claim.—"The arrangement in a chamber exterior to the escape valve, of a porous packing, for preventing noise, during the escape of steam from the heater. Also, the employment of the float valve, in connexion with the heater and pipes leading to the boiler, to prevent the accumulation of condensed steam."

43. For an *Improvement in Telegraphs;* Washington A. Peaslee, Indianapolis, Ind.

Claim.—"The mode of dividing a long line of telegraph into two sections, and transmitting signals from either section to the other, viz: by means of two receiving electro-magnets, at an intermediate station, the helices of which are interposed in the line of main wire, one after the other; said magnets acting in conjunction, upon an armature lever, or its equivalent, which, by the motion produced by the attraction of the magnets, makes contact of a ground wire, or wires, with the main line between the two helices, and the said receiving electro-magnets and armature lever being combined with a spring or other equivalent force, adjusted so as to draw back the armature lever, with a force greater than the attraction of either electro-magnet, but less than the sum of their attractions."

44. For an *Improved Sash Fastener;* William Patton, Towanda, Pennsylvania.

Claim.—"The arrangement of the self-acting catch, or holder, with its staples, on the outside of the window frame and sash, so that it can be more easily placed upon any window, without taking it out of the frame, or be readily repaired, and to prevent the cutting away or mortising of the frame or sash."

45. For an *Improvement in the Mutual Arrangement of Vinegar Rooms and White Lead Corroding Chambers;* Robert Rowland, St. Louis, Missouri.

Claim.—"Arranging the room wherein the metallic lead is placed, immediately above the room wherein the manufacture of vinegar is going on, and perforating the floor between the two rooms, so that the acetic acid, which is generated in the manufacturing of vinegar, may pass from the lower room, through said perforations, into the upper room, and there, in combination with carbonic acid produced in the upper room, by the fermentation of wort, or other similar substance, (or introduced into the upper room by pipes,) act upon the metallic lead, for the purpose of converting the metallic lead into the carbonate of lead."

46. For an *Improved Farm Gate;* Smith A. Skinner, Derby, Vermont.

Claim.—"The manner of making the gate, viz: of a series of bars or chains, and upright chains, connected and arranged so as to fold into, and unfold out of, a recess below the sill. Also, the combination and arrangement of the latch bar and the cords, the same being constructed and applied to the windlass."

47. For an *Improvement in Register Bottle Fastenings;* John Smylie, Philadelphia, Pennsylvania.

Claim—"The spindle with its sliding ball, in combination with the arm, projection, lever, spring catch, and dial, or their equivalents."

48. For an *Improvement in Applying Fire Extinguishing Cartridges;* William Mt. Storm, City of New York.

Claim.—"Simply, the plan of projecting into the flames, with precision and penetrating force, by means of an apparatus or gun, purposely adapted, and by means of a projectile power, independently and separately generated, the fire extinguishing gas gene-

rating, solid itself, in the concentrated and properly adapted form, and moderate, distinct and rapidly intermittent masses, whereby the gas is generated apart from the machine, and within the source of the fire; by all of which, I attain the many points of increased efficiency and convenience of operation."

49. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"In combination with the shuttle and attached thereto, the employment of a spring pressure guide, to control the shuttle thread, as the needle enters the cloth or other substance to be sewed. Also, the continuous feed motion, for spacing the stitches, in combination with the vibratory motion of the needle, imparted in one direction by the feed motion, and in the opposite by a spring or any equivalent therefor."

50. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"1st, The employment of a supporting tongue, placed between and in combination with the two needles, to support the cloth or other substance, and prevent its being puckered during the operation of sewing, and drawing the two rows of stitches tight. 2d, The employment of the guide plates, to guide cloth that has been folded, in making flat or lapped, or other analogous seams, so that the row or rows of stitches shall be made at a regular and determined distance from the folded edge. 3d, The combination, with one or more eye pointed needles and shuttles, or the equivalent therefor, for sewing one or more seams, the employment of a vibrating thread carrier, for carrying a thread or threads alternately in opposite directions, across the seam or seams, and laying it on the face of the cloth, so that it shall be secured to the face of the cloth by the needle thread or threads."

51. For a *Mortising Machine;* Hezekiah B. Smith, Lowell, Massachusetts.

Claim.—"1st, Moving the chisel carriage to and from the wood to be mortised, by power. 2d, In combination, the bent lever, clutches, and pulley stops, or their mechanical equivalent, by which the said chisel carriage will stop its own motion, at or near any desired point."

52. For an *Improvement in Seeding Machines;* H. R. Smith, Massena, New York.

Claim.—"The combination of wheels, with the hopper."

53. For an *Improved Daguerreotype Plate Holder;* David Shive, Philadelphia, Pa.

Claim.—"A daguerreotype plate holder, so constructed, that when its under side is compressed by the hand of the operator, its upper side shall expand, so as to admit of the plate being placed between the hooks thereon, and so that, when the pressure of the hand is relaxed, the said upper side shall contract, causing the hooks to catch upon the outer edges of the plate, and hold it firmly upon the face of the holder."

54. For an *Improved Method of Feeding the Shingle Bolt to Knives;* William J. Scott, Carthage, New York.

Claim.—"The application and construction of the two handled cams. Also, the adjustability of the arms, by means of the bars. 2d, The combination of the rocking lever clutch or hand lever and spring, with the knife frame, for the purpose of feeding intermittingly, the block to the knives."

55. For an *Improvement in Machines for Double Seaming Cans;* Elliot Savage and Noah C. Smith, East Berlin, Connecticut.

Claim.—"The arrangement of the periphery of the bearing roller, that of the roller, the cylindrical portion, shoulder and conical part of the roller. Also, the arrangement and application of two sets of conical rollers, so as to receive and work against the rim of a pan or vessel, and support it."

56. For an *Apparatus for Producing Music by Steam, or Compressed Air;* J. C. Stoddard, Worcester, Massachusetts.

Claim.—"The musical instrument, consisting of a number of what are commonly known as steam whistles, of such tones as to produce a musical scale, arranged in a convenient manner, upon a steam chest, chamber pipe, or generator, and furnished with valves and a rotating studded barrel, finger keys, or other suitable mechanical means of opening the said valves, to allow the escape of steam or air to the whistles. 2d, As a part the said musical instrument, the valve, with its two puppets and seats, of unequal size, and with one end of its stem exposed to the atmosphere."

57. For an *Improvement in Interlocking Grate Bars;* Samuel Vansyckel, Jersey City, New Jersey.

Claim.—"The so casting of grate bars, with projections and recesses on their sides and ends, as that when laid together, they shall interlock, one over, under, or behind the other, in such manner, as to prevent their moving vertically and horizontally, or from warping, whilst they may be readily removed or replaced."

58. For a *Gauge Attachment for Sawing Machines;* George W. Worden, Fayetteville, New York.

Claim.—"The vibrating gauge, formed of the lever with arms attached to its ends, the lever working on a pivot, attached to one of the arms of the sliding gauge, and the arms of the lever working horizontally through the gauge."

59. For an *Improved Card Printing Press;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"The double inclined bed, traversing form, and inking surface, in combination with the lever, spring roller supports, and operating lever."

60. For a *Leading Clasp for Cattle;* Joseph Welton, Waterbury, Connecticut.

Claim.—"The combination of the spring and slide with the clasp."

61. For an *Improved Method of Operating Farm Gates;* John K. Weber, Seneca Falls, New York.

Claim.—"The arrangement of the levers, cords, in combination with the spring bolt, for opening and closing a gate which opens and shuts both ways."

62. For an *Improvement in Argand Lamps;* John G. Webb, City of New York.

Claim.—"The arrangement of the button and deflector, when used in combination with the draft spaces, on each side of the burner or flame, having the relative proportions set forth."

63. For an *Improvement in Lard Lamps;* J. S. Brown, Washington, D. C., Assignor to John Kent, Baltimore County, Maryland.

Claim.—"The combination and arrangement of the open bowl, with its hollow support, the inverted cup, with its air space and enlarged mouth, and the piston."

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64. For a *Dust Deflector for Windows of Railroad Cars;* James H. Cook, Taunton, Massachusetts.

Claim.—"The rotary deflector, or ventilator."

65. For an *Improved Faucet;* Albert Fuller, Boston, Massachusetts.

Claim.—"The use of the devices employed, for ensuring the accurate sealing of the valve, when actuated by a crank, or other positive motion, the same consisting of the screw rod, traveling in the female screw of the nut or eye, formed on the valve stems, and being cut, and constructed, and arranged, with regard to the screw shaft, so as to operate with the same, whereby the valve, or valve stem, when the plug is drawn upon its seat, are brought into the exact position required for enabling the valve to find its proper seat."

66. For a *Bench-Hook;* A. Hotchkin, Schenevus, New York.

Claim.—"The construction of the bench-hook, viz: having the catch or stop attached by a joint to a plate, said catch or stop being provided with a shank, against which a spiral spring acts, and also provided with a segment bar, having holes in one side, in which a spring pawl catches, and retains the catch or stop in the desired position."

67. For an *Improved Projectile for Ordnance;* Andrew Hotchkiss, Sharon, Conn.

Claim.—"1st, Constructing a shot, or projectile, capable of being fired from a cannon having rifle grooves, said shot consisting of three parts, two of which parts are of hard metal, and the other of some flexible expansive material, in the form of a band or ring, attached to one of the hard metal parts, and overlapping the edge of the other, in such manner, that either by the act of loading or firing, or of both, the said ring shall be so expanded, or distended, that it shall take the impression of the grooves, and be made

to fit the bore. 2d, The tail piece, for securing the cap to the body of the shot, and as guide to the cap, on the forward motion."

68. For an *Improvement in Excavators;* Benjamin Hancock, Troy, New York.

Claim.—"1st, The dumping scoop. 2d, In combination with the above, the movable and adjustable frame."

69. For an *Improvement in Vises;* Jasper Johnson, Geneseo, New York.

Claim.—"The combination of lever, swinging lugs, and rack, with one jaw fixed and one movable, in the direction of the rack, to grasp and tighten by one continuous movement of jaw, and admitting of change of capacity without adjustment therefor."

70. For an *Improvement in Wash-Boards;* Joseph Keech, Waterloo, New York.

Claim—"Constructing the operating face of wash-boards, of a laterally depressed and centrally elevated, corrugated surface. for increasing the effective operation of the board."

71. For an *Improvement in Seed Planters;* Ebenezer McCormick, Connellsville, Pa.

Claim.—"So arranging the drag with its link and guides, and the wheels, with regard to a seeding covering apparatus, as that they shall be guides and markers for directing the dropping of the seed at stated intervals."

72. For an *Improvement in Wringers for Clothes;* John McLaughlin, Steubenville, O.

Claim.—"The serrated rotary drum, in combination with the ratchet levers."

73. For an *Impact Water Wheel;* Hiram Morris, Elijah H. Gorton and Edw. Saeger, Crawford County, Pennsylvania.

Claim.—"1st, The buckets so constructed, as to be adjusted and movable, to open and close the issues as may be desired, by means of the circular grooves in the rims of the wheel, and flanches on the buckets, and the studs and bolts passing through the buckets, and fastening the buckets in any desired position, by means of a latch and catch. 2d, A circular concave packing ring, and decking with the adjusting box."

74. For an *Improvement in Churns;* Lewis P. Pease, Mt. Carmel, Illinois.

Claim.—"The winged dasher, formed by two series of carved paddles, rotating around axles projecting outward and slightly upward from a vertical shaft, the said paddles of each series forming a conic frustrum, revolving with its lower edge parallel to the tub bottom."

75. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"The method of protecting the needle from all injury by the interposition of a movable shield, between the needle and shuttle, which is removed after the needle has descended, to permit the shuttle to pass between the needle and the thread."

76. For an *Improvement in Grain Separators;* Benjamin Wright and John Bean, Hudson, Michigan.

Claim.—"The employment or use of the rotating screws and shoe, whereby the straw is carried through the screens, and the grain shaken therefrom within the screens."

77. For an *Inking Apparatus for Card Printing Presses;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"1st, The double armed rock shaft, and outward pressing roller frame, or their equivalents, in combination with the platen and the springs, actuating the arm of said rock shaft. 2d, The mechanism for operating the inking roller, combined with the supply roller, actuated by the movement of the platen."

78. For an *Improved Extension Reach for Carriages;* Edwin Wilson, Prattsburg, N. York.

Claim.—"Connecting the reach to the centre piece of the hounds, by means of the cogged bars, slide and clasp."

79. For an *Improvement in Breech Loading Fire-Arms;* H. B. Weaver, South Windham, Connecticut.

Claim.—"1st, Combining the hammer with the laterally swinging chamber, for the purpose of effecting the simultaneous opening of the chamber and cocking of the hammer by means of the lever, the pin, the slide, and lever arm, all operating, whether said

slide be a priming slide, or simply employed to connect the chamber with the lever. 2d, Combining the priming slide with the lever and the hammer by means of a pin attached to the lever, working in a slot in the slide, or a link attached thereto, so that the lever will draw back the hammer, before moving the slide far enough to allow the pin, through which the hammer strikes the cap, to move out of the receiving hole in the slide, before the slide is acted upon by the lever."

80. For an *Improvement in Washing Machines;* Charles Love, Peru, Illinois.

Claim.—"The construction within the tube, and above its bottom, of a rack, composed of radial fluted cones, each capable of an independent rotation, and operating for facilitating the washing operation."

81. For an *Improvement in Knitting Machines;* John H. Doolittle, Assignor to the American Hosiery Co., Waterbury, Connecticut.

Claim.—"1st, The method of producing the feed motion, by means of a feed bar, with teeth formed upon it, of proper shape, to engage with, and move or feed the series of needles. 2d, The method of reversing the feed motion, by means of the inclined planes, spring bars, swinging bar, and the cam grooves. 3d, Attaching the blocks or inclined planes to the needles, in such a manner that they will always operate at the end of the course, without reference to the number of needles used. 4th, The method of working the counting apparatus, in combination with the method of throwing the machine out of gear."

82. For an *Improvement in Seed Planters;* Francis G. Wynkoop, Assignor to Henry L. Edson, Corning, New York.

Claim.—"The construction and arrangement of the spades with the tube, when attached to and operated by the slide."

83. For an *Improvement in Casting Tea-Pot Spouts and Handles;* Theodore Ackerman, Assignor to H. H. Homan, William Muhle, and Theodore Ackerman, Cincinnati, Ohio.

Claim.—"The use of an inner non-conducting layer, to the metallic interior surface of the cope or sprue gate of a tea-pot spout mould or analogous object."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Correction of the Compass in Iron Ships by Magnets.**

(Continued from page 198.)

Recently, whilst at Liverpool, I had many, opportunities of testing the views I had previously published on the magnetism of iron ships and its changes; and the results, I am happy to say, were, without a single exception, completely satisfactory and accordant. An example, as beautiful as it was conclusive in respect to the correspondence with theory of the magnetic arrangement in the main body of a large iron ship, will here be in place to be described, not only because of its bearing on the question of this section, but of its affording a sound foundation for the proof of organic changes in a ship's original magnetism.

The ship referred to, constructed of iron up to the main rail of the bulwarks, was yet on the stocks, but ready for launching: burden 1400 tons—head E.N.E. The object of the experiments here was to ascertain how far the ship's magnetic distribution externally accorded with deductions from theoretic principles? A clear idea of the nature of these experiments may, I doubt not, be well conveyed by the help of the annexed diagram of the stern elevation and main breadth section of the actual ship.

* From the Lond. Athenæum, Dec. 16, 1854.

In this instance the ship's head being eastward, the polar axis about the main body, theoretically, was expected to run in the direction of the line S N, and the equatorial plane in that of *e q*. Various series of experiments were made,—but the concluding series, which was witnessed by Prof. Traill of the Edinburgh University and others, needs only to be described. The object was to determine by means of a good ship's compass, let down from the main rail, and tried at uniform intervals of three inches of depth, where on each side all deviating action from the ship ceased. I had notified to my friends before entering the yard that, according to theory, the difference of elevation of the place of no attraction on the two sides should be 11 feet. At the conclusion of the experiments, it was found by the notes taken by Prof. Traill, that the place of no attraction on the port side was 6 feet 6 inches down, and on the starboard side 18 feet, difference 11 feet 6 inches,—only 6 inches different from the calculation from theory!

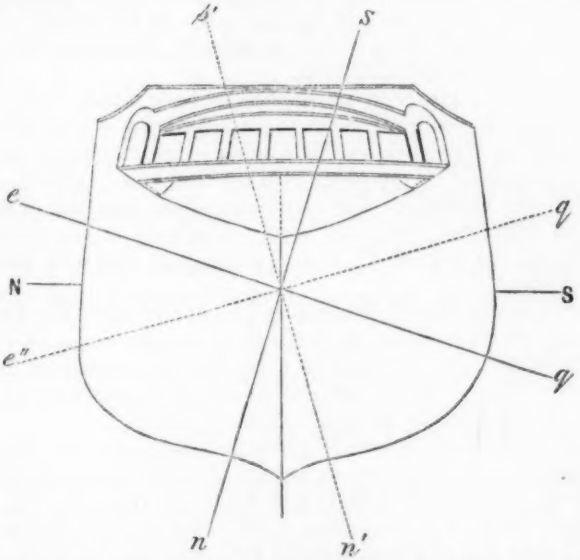
This result was obtained very near the main-breadth section of the ship; but in three or four other positions, separated altogether 64 feet, the variation of the plane on the side that was tried was only a few inches, and the differences quite consistent.

This striking—I may venture to say, beautiful—result, by far the most perfect among the series, because of the condition and position of the ship, will now be employed in the way of proof of the correctness of the opinion I have submitted at the beginning of the section, and of the fact of change, after being launched, in a ship's original magnetic arrangements.

Fortunately for this result, I found another iron ship, the *Imperador*—one of the South American and General Steam Navigation Company's ships of 1740 tons burden—which was just completing her equipments for first putting to sea; and here I obtained the opportunity of making experiments whilst she was being swung for the "adjustment" of her compasses. The *Imperador* had been built with her head lying almost precisely the same as that of the other vessel; and, consequently, her original magnetism must have been very correspondent.

Whilst she was stayed in certain positions for the optician's adjustments, I examined, by the times of oscillation of the needle of a small delicate compass, the places on the two sides, where the needle had its true times of oscillation, and where, of course, the ship had no influence on it. In an *east* direction of the head, where, according to calculation, the difference in elevation of the places of no attraction should originally have been about 12 feet, the actual difference was found to be reduced to *four*. With the head north, the difference appeared to be only about 20 inches. Here, then, we have experimental evidence of a change in the original equatorial plane of the ship of some 8 feet of difference in the two sides,—indicating an angular change in the polar axis of more than 10°. But how had this great, and apparently improbable, change been produced? In the very manner, accidentally adopted, which I had recommended for the modification of extreme magnetic obliquity ['Mag. Invest.' II. 372-5],—by the fixing of the engines and the fitting out of the ship with her head lying *westerly*, or in the opposite direction to that in which she was built.

The great and unusual change which took place in the *Tayleur's* compasses is, if these views be correct, of easy explanation. She had no engines; and her fitting out, there is reason to believe, was unattended with the mechanical violence and particular position favorable for reducing the extreme obliquity of her polar axis. She strained heavily by the gales and seas she met in the Irish Channel. With her head in a westerly direction, her compasses, which originally (before adjustment) had the large deviations of 40° and 60°, changed to an extent of some points. On first reading the evidence on the inquest on the bodies of the unhappy sufferers,



I inferred (as already noticed in the *Athenæum* of Oct. 7,) that the ship, then quite new, had been built with her head northerly or easterly; and that the change in the compasses was due to the shifting of the original obliquity of the magnetic polar axis. I mentioned this conviction to a friend at Torquay, who had relations at Liverpool engaged in the building of iron ships, with the view of obtaining, through them, the information I desired. The fact proved exactly as I had anticipated;—the ship was built with her head towards the north-east, and changed her axis of polarity by heaving and rolling with her head the opposite way.

Here a reference to our diagram will show the nature of the change. The *Tayleur's* axis of polarity must have been something near the direction of the line *n s*. In straining and laboring against the sea, with her head westerly, the tendency of the terrestrial magnetism would be to change that axis into the direction of the dotted lines *s' n'*. The reult would doubtless be an intermediate position. The effect under so large a deviation would, of necessity, be proportionate.

The change, then, which took place in the compasses of the *Tayleur* is in such exact agreement with our knowledge of the *principles* engaged in producing it, and the change in a ship's original magnetic lines is an

ascertained fact so accordant therewith, that it seems to me that the assumption of such changes being impossible must be utterly untenable. Nor is this conclusion essentially affected by the supposition that some part of the compass errors might be due to the *heeling* position of the ship; for no reasonable estimation of the effect of heeling could apply as an explanation of these great changes, much less to the fact of the observed difference betwixt two adjusted compasses.

IV. Having thus considered the bearing of certain positions taken in the paper under discussion, and shown, as I am led to suppose, their untenableness,—we are prepared now to consider the real question at issue, *Whether*, as Mr. Airy contends, *the correction of the deviation by permanent magnets is sound and effective,—or whether*, according to my convictions, *it is fallacious and dangerous.*

It is to myself a matter of satisfaction to have found, with all our recent experience and enlightenment on the magnetism of iron ships, that the principles of my objections to this process of correction,— as indicated in memoranda made on the paper 'On the Rainbow,' in 1839,—have remained hitherto unshaken. The soundness of the principle of adjustment I had then dissented from, and briefly described in the margin of the paper, "neat, but not safe"; even "changes of magnetic intensity will produce errors."

But the question here to be discussed is, not whether Mr. Airy's mode of compass adjustment may or may not, in certain cases, be convenient and useful?—for I have constantly expressed the conviction that it may be:— but whether it is not essentially wrong in principle, and so may delude and endanger the navigator confiding in it?

The principle of adjustment by permanent magnets, fixed in contiguity to the compass, evidently goes on the principle that the magnetism mainly to be corrected is, in like manner and degree, permanent. Mr. Airy, indeed, admits that "the magnetism of an iron ship is *slightly* more liable to change than that of a steel magnet very *carefully* preserved;" but denies that the ship's magnetism is liable to sudden or great changes. The foregoing statements should, I think, go to prove the contrary of this, viz: that in new iron ships, especially, the polar or axial magnetism is exceedingly and essentially liable to change: liable both to great and sudden changes. And this fact is further shown by the general experience and practice of those who are employed in making the adjustments. The first adjustment, are almost always required to be altered. As a general fact, as one of these gentlemen told me, the magnets are required to be *removed further from the compass on subsequent adjustments*, so that the liability to change in new ships is unquestionable; and so also in ships *not being new*, as in the *Ottawa*, the *Ripon*, &c., sudden changes, sometimes considerable and dangerous, have been known to take place. In passing far into the southern hemisphere, indeed, changes, as matters of experience, are, I believe, all but universal. They are for the most part *great* in the measure of action on the compasses, and, often, on rounding the Cape of Good Hope, *sudden*. In such cases, the adjustments by permanent magnets are found (as I ventured to predict when we had but small actual experience as to the facts) to aggravate the error. To instance a few cases, I may mention those of the East India Company's brig *Fame*,

where the errors extended to 57°,—and of the *Three Bells*, of Glasgow, to two points. In the *Royal Shepherd*, the error when near Crozet Island was five and a half points,—in the *Panic*, in 43° S., the error was five points,—in the *Bosphorus* and *Propontis*, as stated in an article in a Plymouth paper, the errors respectively amounted to 30° to 40° and 50° to 60°,—in the *Honey-Moon*, "adjustments were not of the slightest use," &c.

These cases might be vastly extended if all the information I have access to could be used; but in many cases the captains who supplied it objected to its being published without the consent of other parties.

Now, all these cases go obviously to prove that the principle of adjustment must be wrong. An over-compensation appears to be effected, producing an excessive derangement in compasses so adjusted, probably in nine cases out of ten. But if, in certain special cases, compasses so adjusted do act right, as Mr. Airy has shown, what does it prove? A single case of failure, where the correction had been properly made, might strike at the basis of the system; but ten cases of success could not prove its soundness. The compass, in any case, is surrounded by innumerable masses of iron and combinations of ribs and plates, which, to very considerable extent, tend to *compensate* one another's deviating influence; and so, that if a ship could be built with her two sides perfectly and rigidly alike, as to quantity, thickness, hardness, and mechanical action thereon, then we should expect to find a central position,—after the axial obliquity had settled into a medium condition,—where *changes* might go on correspondingly, and the compass, generally, act correctly. Hence, where circumstances approach this condition, the compass in the iron ship may act very well. Cases of this kind are well known. That of the *Great Britain* is a striking instance.

In the case of correctly-acting adjusted compasses, of which Mr. Airy has adduced examples, it remains perfectly uncertain on what quality of the deviating magnetism the adjustment had acted: whether on the inductive or retentive, or on both. Nor is it clear whether the changes in one quality may not have accidentally compensated the changes in the other. The successful cases are no satisfactory set-off against the crowd of failures; but *any one failure* may endanger the navigator who submits himself unsuspectingly to its guidance.

The prevalent failures in adjusted compasses become at once evident against the theory of *permanent* magnetism existing in iron ships, and in favor of the theory of the more enduring quality being *retentive* magnetism,—changeable, under an opposite direction of terrestrial magnetism, by mechanical action; not changeable to a *slight* and unimportant extent, but, as is indicated by its disturbing effects on the adjusted compass, in a very *considerable* degree.

According to the obvious principles of magneto-mechanical action of iron, described in section I., the entire magnetism of a ship would be inverted, if we could upset the ship here, and impress a due quantity of mechanical action on the structure; or, what is the same thing in an *opposite* magnetic latitude, in the southern hemisphere, if such mechanical violence were in ample measure applied. The actual change, then, in the case of a ship sailing or steaming into a southern magnetic latitude

will depend on the height of the latitude attained, and the measure and universality of the mechanical violence on the hull of the ship. The vibration or straining may affect the main body, perhaps, both plates and angle irons, and yet, from the singular bracings and defence against special action in the *stem* and *stern-post* and *contiguous angle irons*, may not be able to reach them. In this case, the retentive magnetism of these large and powerfully acting masses of iron might be but in a small measure disturbed, and so leave, for some considerable time, the original polar axis still dominant.

But here experiments are wanting to determine the facts. Such experiments as those I tried on the *Elizabeth Harrison* and *Imperador* (section III.) would soon enable us to arrive at just conclusions, whilst the mere testing of the magnetism of the top-sides of iron ships, of the magnetic intensity of the upper parts of the stem, and stern-post and angle irons, would greatly enhance the appliance for sound and complete theoretic principles. That a ship's magnetism at the Cape, or at Australia, should, therefore, remain positive or negative, the deviation easterly or westerly, or in the same *direction* as when she sailed, in no way invalidates what I have here submitted as being the *tendencies* of principles, but only extends to effects as to their *degree* of elicitation.

In submitting these views as to the unsoundness in the principle of the correcting of compasses by compensating magnets, I feel it due to Mr. Airy, as well also to myself, to say, that it by no means follows that the process may not, for certain circumstances and voyages, be both convenient and useful to the navigator. I have in all cases, where the subject has been thoroughly gone into, expressed the opinion that, with due caution and distrust on the part of the navigator, such adjustment may for a particular compass, be found of considerable convenience. But the applicability here is found to have practical limits—perfectly consistent with theoretic deductions—as regards changes in magnetic latitude.

Mr. Airy, indeed, seems to admit this fact when he says: "For voyages of moderate duration, as, for instance, not further than to the Mediterranean, or to the northern parts of North America, I do not think that any improvement can be made in the existing system." This opinion I am so far from disputing, that, reserving the exceptions of particular changes in the ship's magnetism, I believe it may operate favorably, as shown in "Magnetic Investigations," Vol. II. p. 337, and in the report in the *Athenæum* of October 7, within the limits assigned. And this for satisfactory reasons, as stated in the passages referred to. The dominant compass-disturbing influence in a ship built in this country is the *retentive* magnetism of the *upright* iron. This, whilst in latitudes having considerable northerly dip (as in the case defined), has all the effect of *permanent* magnetism from its being terrestrially sustained,—that is, whilst the earth's inductive force lies mainly in the same direction as that of the ship's principal polarity, mechanical violence can have little tendency to change it.

It is the *horizontal* magnetism here, by far the weakest part, which tends to change; and this no doubt will change by repetitions of mechanical violence under certain changes in the ship's course. From the magnetic latitude of England to that of the Mediterranean, the tendency

to change the retentive magnetism of upright iron is extremely small; but beyond the latter, southward, the tendency to change rapidly increases, and in southerly dip must go on with an increasing *tendency to upset* the original polar axis of the ship, as the southerly inclination increases.

V. Here it may not be thought uncourteous, I trust, if I question once more a portion (Sect. II.) of the paper under discussion,—as to *whether objection to the term Retentive Magnetism being given by me to the more fixed part of a ship's polarity, should be maintained on the ground of Mr. Airy's researches on the "Rainbow"?*

Perhaps I do not correctly apprehend the meaning of Sect. II. of the paper; but the points of real importance therein are, I think, sufficiently explicit. To Mr. Airy is most justly due the experimental determination of the fact of the existence in iron ships of *two qualities* of magnetism; and also the elegant application of mathematical talent for the elucidation of their relative influences and properties.

But in regard to the *quality* I have designated as above, I submit the claim for doing so on the ground of having investigated and elucidated that quality, as developed by mechanical action, in the year 1819,—long before iron ships were known. But the question here arises—which is of essential importance in our whole discussion, and therefore should be well considered—whether the more fixed quality of a ship's magnetism be of the kind I refer to, or one characteristically different? Mr. Airy considers it to be "*slightly* more liable to change than that of a steel magnet *very carefully* prepared"; and "to differ very little from the magnetism of hard steel bars." Hence it seems to be implied, that the term by which it was designated almost throughout the paper on the Rainbow—that of Permanent Magnetism—conveys the real characteristic of the quality, as contemplated by Mr. Airy;—an inference plainly pointed to, I think, by the adoption of *permanent* steel magnets as correctives.

That there may here be no misunderstanding as to what I consider the characteristic differences in the several kinds of magnetism, I shall notice, though at the expense of some repetition of the article at p. 1206 of the *Athenæum*, a set of experiments by which I have been in the habit of exhibiting the three qualities of *Inductive*, *Retentive* and *Permanent Magnetism*. For this I take two slips of thin sheet iron and another of elastic steel. The first, I, I free entirely from magnetism: the second, R, I render strongly magnetic by bending, vibrating, or hammering in an upright position: the third, P, I render magnetic by one of the usual processes. Now it will be noted that the differences are most characteristic. Plate I, being held upright near a delicate compass, is found to be indeed magnetic, but to change its polarity if inverted, and if brought near the compass in an east and west horizontal position, to be neutral as at the first. The second plate, R, being held upright near the compass, north pole downward, is found to be powerfully magnetic, and if inverted, though less powerful, it yet retains its original polarity; and being finally brought near the compass in an east and west horizontal position, it exhibits (provided it has not been affected by vibration or bending) the same magnetic energy as the first. But, if whilst being held in a horizontal or an upright reversed position, the plate be now vibrated or bent, the original

magnetism will be either neutralized (nearly) or the polarity completely reversed. This quality I have named *retentive* because its polarity is *retained*, whilst no adverse action, mechanically urged, tends to change it. The steel plate, P, will of course have vigorous action on the compass; but its power is found to be *actually permanent*, or at least not capable of being very greatly affected by the most trying employment of mechanical violence. Let it be turned with its north pole upward—a position in which the ordinary retentive magnetism cannot stand a blow or any obvious flexure without change—and then bend it indefinitely often, or strike it in any imaginable manner, and the magnetism, if the steel be good, will undergo but little if any change.

The difference here indicated, therefore, betwixt the magnetism developed in malleable iron and that of good steel bars duly prepared, is most characteristic and conspicuous; the one is controllable by mechanical action under the proper changes of position, the other is not. With the latter, Mr. Airy's compensation clearly accords; but such compensation cannot agree with the changeableness of magnetism developed by the mechanical action of building a ship. And, I may add, if no separate portion taken out of an iron ship can retain its magnetism if hammered in a position opposite to that in which its original polarity was developed, it is not conceivable, I think, that a ship's magnetism, if so treated and under like circumstances, should remain in anything like permanency.

Hence, I apprehend, the denomination of *retentive magnetism* which I have suggested should, if it be not altogether inconsistent with the quality, be conceded to me on the ground, first, of the precedence in date of my original researches; and, secondly, on the ground of the more fixed quality of magnetism in iron ships, as contemplated by Mr. Airy, being essentially and characteristically different from what I have named retentive magnetism. Or, if this latter ground should not be conceded, I would respectfully submit what appears to me to be a dilemma:—That if, on the one hand, the more fixed magnetism be *not permanent*, in nature at least, like that of hard or tempered steel magnets, then the mode of compensation for all regions by such magnets must be scientifically unsound; but if, on the other hand, it *be* permanent in the nature of steel magnets, then no objection, from hence, can lie against my designation of *retentive magnetism* as a quality, which is essentially different.

If these observations on the paper "On the Correction of the Compass in Iron Ships" have extended to an unwonted length, I trust the importance of the subject, both as to commerce and humanity, (where iron as a material has come into such prevalent use in ship-building) will justify the course I have taken in endeavoring to bring the whole case, according to my personal views of it, fairly before the reader. The facts herein given I submit with perfect confidence to Mr. Airy's consideration; the inferences and arguments which I have associated with the facts must apply according to their soundness and deservings.

In conclusion, I have only to add, in respect to any impression my observations here or elsewhere may have made as to the difficulty, if not unsafety, of compass guidance in iron ships,—that my impression has always been, and has constantly been expressed, that such difficulty, or

tendency to mislead the navigator, is by no means a *necessity* in regard to ships built of this highly magnetic material. Even now, an immense fleet of iron ships traverse every part of the ocean, and with such measure of comparative safety as serves for their being insured at ordinary premiums. But, whatever may be the practical results at present, as to comparative safety, it would not be difficult, on the plan referred to, to render them *more* safe. The liability to compass changes, which I have pointed out, may, I doubt not, be guarded against, and the evil tendencies prevented by *a standard compass aloft*. This plan I employed myself more than thirty years ago, and have continually urged its adoption for a compass of reference in iron ships. In a letter to the Liverpool Underwriters' Association, I have gone into the details of the plan and the evidences of its general efficacy—evidences derived from many actual cases in which it has been applied, and from a special case in the iron ship *Imperador* referred to in section III. of this paper. Here I had the opportunity of determining the fact, that, where every compass on the saloon deck was subject to an error of from two-and-a-half to three-and-a-half points, a compass raised, in this instance, only thirty-two feet above the deck, was perfectly true on every direction of the ship's head whilst she was swung for the purpose of compass adjustment.

WILLIAM SCORESBY.

Torquay, Dec.

For the Journal of the Franklin Institute.

On Colombian Guano; and certain Peculiarities in the Chemical behavior of "Bone Phosphate of Lime." By CAMPBELL MORFIT, M. D.

This guano was originally introduced into commerce as "*Maracaibo Guano*," and hence is supposed to come from some islands in the Carribean Sea near the coast of that country. Its source, however, is not definitely known, except to those who monopolize the trade in the article.

Its high character as a fertilizing agent, and the discordant results of analyses already on record, having prompted a careful examination of it, I herewith present a report of my research.

As brought, it is in lumps with a compact interior of a chocolate brown color, and a grayish white mammillated exterior resembling an enamel. Between this enamel-looking portion and the compact interior is a lighter brown, porous, stratum. The whole reduces without much difficulty under the pestle, with a dull even fracture, and gives a brownish gray powder.

To insure the complete integrity of the investigation, a large sample of several pounds was procured directly from the State Inspector, and a fair average adjusted by selecting, in equitable proportion, about four ounces from the different phases of the whole mass. The natural form is preferable for analysis, because the powdered article of commerce is liable to admixture with foreign matters which get in accidentally or otherwise during the process of grinding.

The numbers obtained from it are as follows:—

SPECIFIC GRAVITY 2·28.

Accidental moisture,	·500
Constitutional water, expelled at 212° F.,	1·500
" " " " above "	5·100
Organic matter soluble in acid,	1·490
" " " water,	·800
" " insoluble in either acid or water,	·340
Sand and insoluble inorganic matter,	·490
Carbonic acid,	·060
Chloride ammonium,	·090
Soda,	traces.
Magnesia (soluble,)	·010
Phosphate lime (soluble,)	·210
Sulphuric acid,	3·230
Phosphate iron ($Fe_2 O_3$,)	·920
Phosphoric acid,	39·587
Lime,	40·565
Phosphate magnesia,	5·930
	100·822

The accidental water was estimated by drying a given quantity of fine powder in vacuo, over sulphuric acid, and noting the loss of weight. This latter deducted from the further loss sustained by heating the residue over a water bath, until the weight became constant, gave that part of the constitutional water expelled at 212° F. The remaining water of constitution was determined by heating a new quantity of the guano in an atmosphere of carbonic acid, taking the weight of the aqueous distillate which is the totality of water in the guano, and deducting from it the preceding two weights.

To ascertain the gross amount of volatile matter, a given portion was incinerated, and the calx weighed for loss. When at a subsequent stage, the carbonic acid, chloride of ammonium, and organic matters soluble in water and insoluble in acid were severally determined, being a part of the gross volatile matter, they were, together with the combined weight of the three waters, subtracted from it to get the weight of organic matter soluble in acid as expressed by the residue.

A separate quantity of 200 grains was taken for the soluble matters, and digested with sixteen fluid ounces of distilled water, in successive instalments, filtered and washed. The filter was discarded; and the filtrate evaporated over water bath to one-fifth of its volume, after which, it was divided by weight into two equal portions A and B.

From A, the sulphate of lime was precipitated by alcohol, and after 12 hours repose, filtered off and washed with dilute alcohol. Not deeming it expedient to estimate the sulphate of lime in this way, owing to the uncertainty of dissolving out the entire content, even with a large volume of water, the filter was discarded. The filtrate, after evaporation over water bath, to drive off alcohol, was tested with ammonia which threw down the phosphate of lime existing as biphosphate. This being separated by rapid filtration, the filtrate was set aside for 24 hours, at the end of which time crystals of $N H_3$, H O, 3 Mo O, PhO_5, 12HO, had formed from the magnesia combined with the phosphoric acid, which was (as will hereafter be shown) retained in the liquid—the normal state of the magnesia having been sulphate.

The soluble organic matter was estimated from B by adding a slight excess of caustic soda-ley to promote elimination of ammonia, and carefully evaporating to dryness in a tarred platinum capsule, over a sand bath, and noting the weight when it became constant; the organic matter having been, then, burned off over the naked fire, the weight was again tested, so as to get the loss which represents its amount.

To separate the ammoniacal salt which, in preliminary qualitative examination, was found to be chloride, but in very minute proportion, I employed a method that yielded only approximate results, but sufficiently exact under existing circumstances.

To avoid any possible loss, by volatilization, in the use of hot water, a fresh quantity of 100 grains of the powdered guano was displaced with cold water, and the solution evaporated over water bath as before, but in this instance, the soda-ley being omitted. When the weight became constant, it was noted; and a red heat afterwards applied and continued until the entire expulsion of both the ammoniacal salt and organic matter. As the loss of weight by this last heating represents these two latter combined, it was only necessary to subtract from it the weight of organic matter previously determined in B to ascertain that of the chloride of ammonium.

For the sulphuric acid and insoluble matters, another 100 grains of the powdered average was digested in pure nitric acid at 212° F., to perfect solution—that which is of uncertain attainment when hydrochloric acid is used, as it acts slowly, and in some instances, imperfectly, and may possibly leave some of the guano undissolved. The solution was diluted and filtered upon a tarred filter, washed with hot water, dried over water bath and in vacuo to get its constant weight, then incinerated, and the calx weighed as sand and insoluble inorganic matter. This latter deducted from the constant weight of the unburned filter, gave the amount of organic matter insoluble in either acid or water.

The sulphuric acid was separated from the filtrate with nitrate of baryta and deduced by calculation from the precipitated sulphate of baryta, which was well washed with nitric acid and hot water previous to being ignited.

Although the filtrate from the sulphate of baryta might be used for the estimation of the remaining components—lime, magnesia, iron, and phosphoric acid—we deemed it advisable to reject it, as the precipitates from so large a quantity of guano as 100 grains would be bulky and not nicely manageable. A new portion of 20 grains was, therefore, substituted and digested in nitric acid and filtered as before. The lime was then precipitated from the filtrate by pure sulphuric acid and alcohol, filtered off after several hours repose, washed with dilute alcohol, ignited and weighed, and the lime deduced by calculation from the sulphate. The entire absence of lime from the filtrate, having been proved by treating a drop with oxalate of ammonia, it was then evaporated over water bath to drive off alcohol, super-neutralized with aqua-ammonia, left at rest 24 hours, for the subsidence jointly of the phosphate of magnesia and phosphate of iron, and filtered. The filtrate having been covered and set aside as C, the filter was displaced with hot acetic acid, which dissolved out the magnesia salt and left the phosphate of iron. This latter

was then washed, dried, and ignited; ammonia was in the meantime added to the filtrate, which, after some hours, dropped all the phosphate of magnesia retained in solution by the acetic acid.

From the filtrate c, all the remaining phosphoric acid was separated by a clear solution of sulphate of magnesia and filtration, after 24 hours repose.

The carbonic acid was determined in the usual way, by means of Bunsen's apparatus.

Upon critical examination of the results, it will be observed that the lime, magnesia, phosphoric acid, and water, are in such proportions, that it is impossible to combine them together in accordance with any known formulæ. After minor allotments of lime to the sulphuric and carbonic acids, and the apportionment of the phosphoric acid due to the phosphate of lime to restore it to its original state of bi-sulphate, there is, with that portion to be taken from the phosphate of iron (naturally existing as $Fe_2 O_3$) enough phosphoric acid to convert all the residual lime into bone or tri-basic phosphate (3 CaO, PhO_5,) and 7·171 grains to spare.

Now the figures do not allow the hypothesis, that a part of the phosphate of lime, may be neutral phosphate. Nor can any of the lime and phosphoric acid be combined as bi-phosphate in allotropic condition; for though it is true that, bi-phosphate of lime loses its solubility upon being highly heated, yet the physical characters of the guano and the presence of water and organic matter preclude the possibility of its having undergone igneous action. Moreover, it was found that cold water, even in large quantities, would not dissolve out a greater quantity of phosphate, than ·210; still, it must be mentioned, on the other hand, that certain peculiarities of behavior were encountered in preliminary essays. It was observed that the filtrates from the precipitate thrown down in a nitric solution of guano at 212° Fah., by aqua ammoniæ, invariably retained phosphoric acid; and in one instance estimated, to the amount of 4·27 per cent. When the precipitate was in the cold, there was always an accompaniment of lime, but when the nitric solution was boiling, and the precautions recently directed by Denham Smith (*Chem. Gaz.* 1855, p. 203,) were strictly observed, the proportion of lime was reduced to mere traces. On repeating these experiments, with pure bone phosphate and also with bone black, precisely the same result ensued. What relation to quantity may exist between the circumstance of temperature, state of dilution and acidity, is a matter for future experiment and explication. Suffice it to say, that phosphoric acid was always left in solution with the ammonia; and what is also remarkable, the phosphate of lime thrown down from the *hot* nitric solution of guano, always presented, to a limited extent, a most obstinate resistance of the solvent action of acetic acid; thus indicating the formation under the circumstances of an unknown compound, or the assumption of a passive state.

The question then arising as to the original condition of the phosphoric acid retained by the ammonia, an experiment was instituted to determine whether it could possibly have been uncombined. One hundred grains of the guano were boiled in successive portions of distilled water, and the mixed liquids filtered. The filtrate gave an instantaneous acid re-action, and, upon being treated with ammonia and left to repose, drop-

ped both the phosphate of lime and magnesia, there being, not even a trace of lime salt left in solution. When these were filtered off and the filtrate treated with sulphate of magnesia and chloride of ammonium, it yielded upon repose, 2·11 grains phosphate magnesia = 1·35 grains of phosphoric acid. This result having brought to mind the fact of neutral phosphate of magnesia being easily decomposed, by continued boiling with water, into free phosphoric acid and a basic phosphate, (3 MgPh, Os, 7 HO,O,) the portion of phosphoric acid in question was about to be referred to that source; when as a suggestive of the over large quantity and of the above noted peculiarity of magnesian phosphate, the experiments were extended to comprise pure bone phosphate of lime and with nearly analogous results. When boiled with hot water and filtered, the filtrate gave an immediate precipitate, of phosphate lime with ammonia. The same filtrate, after being entirely freed from lime by pure sulphuric acid and alcohol, gave when treated with a mixture of chloride of ammonium and sulphate of magnesia, a considerable quantity of ammonia—magnesian phosphate. A decomposition of the bone phosphate, by the boiling water, was thus evident, but in a different degree from the phosphate of magnesia; for the phosphate of lime in leaving a portion of its acid free, separates partly in a soluble form; whereas, the basic magnesian salt formed under the same circumstances is insoluble.

These facts having indicated the inadmissibility of hot water for the experiment, one hundred grains of the average sample of guano were then leeched with cold water in a displacement tube of one inch diameter and two feet length. The clear liquid running through contained some little bi-phosphate of lime, but only traces of free phosphoric acid.

In conclusion, therefore, it follows from these experiments:

1st, That Colombian guano does not contain either free phosphoric acid, or soluble phosphates, in proportion beyond the ·329 of bi-sulphate of lime.

2d, That as Denham Smith had previously shown (*Chem. Gaz.* 1855,) there are certain precautions requisite, as regards temperature and state of dilution, to insure the entire precipitation of lime by ammonia, from an acid solution of bone phosphate.

3d, That in precipitating phosphates of lime and magnesia with ammonia from an acid solution, under the ordinary circumstances as well as those above mentioned, there is always a variable portion of phosphoric acid left in solution; and therefore, this method so generally followed for the quantitative estimation of the earthy phosphates in guano is inaccurate.

4th, That bone phosphate of lime is partially decomposed by prolonged boiling with hot water into free phosphoric acid and a soluble phosphate of lime.

5th, That the atomic constitution of the earthy phosphates is still an open question, and consequently correct formulæ cannot be constructed from my results.

6th, That the Colombian guano is rich in phosphoric acid and lime; and theoretically, as to these constituents, its money value is far greater than that of bones.

University of Maryland, Baltimore, October 1, 1855.

On the means of Realizing the Advantages of the Air Engine. By William John Macquorn Rankine, Civil Engineer, F. R. SS. Lond. and Edin., &c.*

(Read to the British Association for the Advancement of Science, Section G, at Liverpool, September, 1854.)

(Continued from page 258.)

Section II.—On the Actual Efficiency of Thermo-dynamic Engines: of Steam-Engines in Particular.

12. *Causes of Waste of Heat and Power.*—In considering the waste of heat and power which constitutes the difference between the actual performance and the maximum theoretical performance of engines worked by heat,—as the object now in view is to compare different kinds of engines together, it is not necessary to take into account those causes of loss of power which either are or might be made nearly alike in all kinds of engines, such as the friction of the machinery; those causes alone will be considered which affect the relation between the expenditure of heat and the action of the working elastic substance upon the piston,—in other words, the *indicated* power of the engine; and from these causes will be further excepted the waste of power in forcing the working substance through narrow valve-ports and passages, as this kind of waste arises only from an error in mechanism. As thus restricted, the causes of waste of heat and power may be divided into five classes—*first*, Imperfect communication of heat from the burning fuel to the working substance; *second*, Imperfect abstraction of the heat, which constitutes the *necessary loss* explained in the preceding section; *third*, The communication of heat to or from the working substance at improper periods of the stroke; *fourth*, Any expenditure of heat in elevating the temperature of the working substance; *fifth*, Imperfect arrangement of the series of changes of volume and pressure undergone by the working substance during the stroke. The fourth and fifth causes of waste are often connected with each other.

13. *Application to the Steam Engine.*—In the steam engine the first cause of waste of heat exists when the boiler presents an insufficient surface to the products of combustion, and may be considered to be almost completely removed in tubular boilers of the best construction when properly worked. It is well known that, with such boilers, the consumption of fuel per horse-power per hour is about one-fifth, of what it has in some instances been ascertained to be where boilers of insufficient surface have been employed. The second cause of waste exists where the condensation is imperfect. The third cause of waste, where the cylinder, steam-passages, and boiler are exposed to the loss of heat by conduction and radiation.

As the means of indefinitely diminishing the waste of heat in steam engines from those three causes are already to a great extent practised, it is unnecessary here to refer to them farther.

14. *Action of the Steam in a Perfect Steam Engine.*—To understand the mode of operation of the fourth and fifth causes of waste in the steam engine, let us consider what the action of the steam in a theoretically

* From the Lond. Philos. Jour., January, 1855.

perfect engine ought to be. We shall commence with the process B of the cycle constituting the stroke, described in article 6. An assigned portion of water being at the required temperature of evaporation, is converted into steam at that temperature, and at a pressure depending on that temperature, by the expenditure of a certain amount of heat, called the *latent heat of evaporation*, which also depends on the temperature. The steam being admitted to the cylinder, propels the piston before it; and when the assigned portion of water has been thus admitted in the form of steam, the communication with the boiler is shut. This completes the process B.

The steam now, without receiving or discharging any heat, expands: during this expansion its temperature falls by the conversion of heat into mechanical power; the pressure, of course, diminishes at the same time: this expansion ceases when the pressure and temperature of the steam have fallen to the degree fixed for its condensation. This completes the process C. During the process D, the piston returns, and a portion of the steam is liquefied by contact with some cold conducting substance, which abstracts the heat generated by its liquefaction, so as to maintain it at the fixed temperature and pressure. The process D ought to stop in time to leave a portion of uncondensed steam sufficient for the process A, now about to be described. The water and steam being now prevented from receiving and discharging heat by conduction, the piston continues its return stroke, and forcibly compresses the remaining portion of steam into the liquid state. This constitutes the process A; and the portion of steam so condensed ought to be just sufficient, by the heat generated by its liquefaction, to elevate its own temperature, as well as that of the water previously liquefied, to the original temperature of evaporation, so that the entire portion of the water employed may be in every respect in the same condition as it was at the beginning of the cycle of processes B, C, D, A, which may be repeated *ad infinitum*. Such an engine would fulfil the conditions of maximum theoretical efficiency; for the elevation of the temperature of the water would be effected without expenditure of heat, and the only heat expended would be the latent heat of evaporation: those results being produced by the proper arrangement of the changes of volume and pressure undergone by the working substance during each stroke.

15. *Impracticability of such a perfect Steam Engine.*—It is impossible to fulfil wholly in practice the conditions prescribed in the preceding article. To show the nature of the obstacles, let us begin with the process A. The forcible compression of a certain proportion of the steam into the liquid state, would not only cause a very inconvenient degree of inequality in the action upon the piston at different periods of the stroke, but it is difficult to conceive any mechanism by which it could be effected in practice. The steam must therefore be wholly liquefied during the process D, and the temperature of the feed-water must be raised from the point of condensation to that of evaporation by expenditure of heat. A certain amount of heat is thus wasted; at the same time the power which would have been expended in compressing the steam is partly saved; but the saving of power bears a small proportion to the mechanical equivalent of the heat wasted.

The amount of waste thus occasioned is comparatively unimportant in practice, provided it be not increased by unskilful methods of heating the feed-water; for, under ordinary circumstances, the heat required for that purpose seldom exceeds one-seventh part of the latent heat of evaporation, and it may be considered to reduce the efficiency of the engine below the theoretical maximum by about one-sixteenth.

Another and more important point in which the conditions prescribed by theory cannot be exactly fulfilled, is the extent of the expansion during the process C: if this expansion were carried in practice down to the pressure of condensation, the cylinder and every part of the engine would be bulky, heavy, and costly, and the action of the steam upon the piston, during the latter portion of the stroke, would be so feeble as to cause an unsteadiness of motion unsuitable for the driving of machinery. The expansion, therefore, cannot be fully carried out. The diminution of efficiency from this cause depends upon the extent to which the expansive working is carried. Should the expansive working be wholly omitted, the efficiency may be reduced to one-third or one-fourth of its theoretical value, or even less, according to circumstances.

16. *Actual Efficiency of well-constructed Steam Engines.*—In single-acting engines for pumping water, in which the difficulties of employing a great extent of expansive working are the least, the actual efficiency has already, in some cases, attained a value nearly approximating to its maximum theoretical value. In double-acting engines, however, so long a range of expansive working cannot be employed; and their ordinary average consumption of coal, when skilfully made and worked, is four pounds per horse-power per hour, the coal being of the evaporating power already specified. This corresponds to an efficiency represented by 0·0825, being about 0·46 of the theoretical maximum.

Considering that the causes of waste of heat and power in the steam engine are, as has been already explained, incapable of being wholly removed in practice, it may be estimated that the greatest amount of actual efficiency to be expected in double-acting steam engines by any probable improvement, is about three-fourths of the theoretical maximum, or 0·133,—corresponding to a consumption of coal, calculated as before, of $2\frac{1}{2}$ lbs. per horse-power per hour.

SUPPLEMENT TO SECTION II.—*On the Steam and Ether Engine of M. du Trembley.*

(16 A.) This engine exemplifies one means of diminishing that difficulty attending the fulfilment of the conditions of theoretical perfection in the steam engine, which arises from the impracticability of expanding the steam until its pressure has fallen to that corresponding to a low temperature of condensation.

Instead of carrying the expansion of the steam to the great extent required by theory, it is carried to such an extent only as is convenient in practice. The steam is then liquefied at the pressure attained at the end of its expansion, and the heat given out during its liquefaction is employed to evaporate ether, which works an auxiliary engine. By this process, after the expansion of the steam has been carried to a certain extent, *vapor of ether* is in fact *substituted for the steam* and made to perform the

remainder of its work in its stead ; and as the vapor of ether, at a given temperature, exerts a higher pressure and occupies a less volume than steam does, the cylinder of the auxiliary ether engine occupies much less space, and gives a more steady action than would be required for the performance of the same work by continuing the expansion of the steam.

The maximum theoretical efficiency of the steam and ether engine is the same with that of any other thermo-dynamic engine working between the temperature of evaporation of the water, and that of liquefaction of the ether.

Its advantage consists in obtaining a nearer approximation to that theoretical efficiency within given limits as to the bulk and cost of the engine, than is practicable with an engine worked by steam alone.

Section III.—On the Actual Efficiency of Air Engines.

17. As the object of this paper, in referring to the actual performance of previous air engines, is to illustrate the waste by which that performance falls short of the theoretical maximum, I shall refer to those engines only which have actually been at work, and the details of whose performance have been made public with tolerable precision, namely, the engine of the Messrs Stirling, and that of Captain Ericsson, which latter was used for marine propulsion about the year 1852.

18. *Stirling's Air Engine.*—In describing generally the air engine which was invented by the Rev. Robert Stirling in the year 1816, and improved by him and Mr. James Stirling at subsequent periods, it will be sufficient to speak as of a single-acting engine only ; a double-acting engine having simply a similar apparatus for each side of the piston.

Suppose a cylindrical cast-iron air-receiver, of sufficient strength to be safe with a working pressure of sixteen atmospheres, with a convex hemispherical bottom, and a concave hemispherical top, to be placed in a vertical position over a flue connected with a furnace, but screened from the radiant heat ; the hemispherical bottom of this receiver constitutes the surface for the reception of heat ; I believe it was 3 inches thick in the engine last erected. Within this vertical receiver there is a hollow metal plunger, filled with some non-conducting substance, and capable of being moved up and down by means of a rod. This plunger is of precisely the same form with the receiver, but considerably less in height, and somewhat less in diameter. The effect of raising this plunger is to displace the air from the upper part of the receiver, and to send it down to the bottom, where it is exposed to heat ; the air passing through the space between the plunger and the sides of the receiver : the effect of lowering the plunger is to cause the air to return to the top of the receiver. In the interior of the uppermost part of the receiver is a coil of small tubes, in which cold water is made to circulate, and amongst which the air must pass whenever it is displaced. Lower down, and occupying the annular space between the plunger and the receiver, are a number of parallel vertical plates of metal or glass, with narrow interstices between them, through which the air must pass on its way up or down. This system of plates is called the *Economizer* or *Regenerator ;* its object being one which has already been explained in article 8, namely to store up the heat given out by the air during process C, when its temperature is being lowered,

and to give back the same heat to the air during process A, so as to raise its temperature. Lower still, the receiver has an internal false bottom, pierced with many small holes, through which also the air must pass, and whose effect is to bring every part of the air into close contact with the heated iron bottom of the receiver. Suppose, further, that this receiver communicates at its top, through a sufficiently wide passage or nozzle, with the lower end of a working cylinder containing the piston; the receiver and cylinder are, in the first place, filled with compressed air, of any required density, by means of a small forcing-pump. As the same mass of air is used over and over again, this pump has to be subsequently worked to no further extent than is necessary to supply the loss of air by leakage, which has always been found to be extremely small. A pump is also required to keep up a stream of cold water through the coil of tubes before mentioned.

19. *Mode of operation of Stirling's Air Engine.*—Suppose the piston to be at the bottom of the cylinder, and the plunger at the bottom of the receiver, the mass of air in the receiver is now at the top amongst and near the cold-water tubes, and its temperature is low. Let the plunger now be partially raised, part of the air is forced down through the economizer into the space between the outer and inner bottoms of the receiver, and through the holes of the inner bottom, into the space below the plunger. In passing over the heated bottom of the receiver, it has, in the first place, its temperature raised by the reception of heat from the furnace. At this point the cycle of processes formerly described may be held to begin.

Process B.—The air below the plunger receives an additional supply of heat from the furnace, which disappears in expanding it. The air below the plunger, in the act of expanding, lifts up the plunger and the mass of air above it, which latter mass of air, passing through the nozzle, lifts the piston.

Process C.—The plunger descends and forces the air below it through the holes of the inner bottom, and through the metal or glass plates of the economizer, which absorb, more or less completely, the sensible heat of the air. This air, by passing amongst the cold-water tubes, enters the space above the plunger. Should it leave the economizer at a temperature higher than that of the cold-water tubes, the latter abstract an additional portion of its sensible heat.

Process D.—The piston descends, compressing the whole mass of air; the heat so generated is abstracted by the cold-water tubes.

Process A.—The plunger partially rises, as before; a portion of air descends through the economizer, and recovers the heat remaining stored up there. Should its temperature, on leaving the economizer, not have attained its original elevation, the additional sensible heat required is supplied from the furnace through the bottom of the receiver.

The cycle of processes is now finished, and may be repeated *ad infinitum*.

Thus, it appears, that the air confined in the receiver and cylinder of Stirling's air engine consists of two portions: one portion, which always remains above the plunger, and which serves merely as a perfectly elastic cushion, to transmit pressure and motion between the piston and the

other portion of the air, and not as a means of developing power; and another portion of air, which, being driven by the plunger to the bottom and top of the receiver alternately, is successively heated, expanded, cooled, and compressed; and, as the expansion takes place at a high temperature, and the compression at a low one, more power is produced by the former than is consumed by the latter, and thus there remains a surplus of available power for the engine.* The existence of the cushion of air before mentioned, leads to an important practical advantage; for it is this air alone which comes into contact with the cylinder, the piston, the packings of the piston, and those of the plunger-rod, which are consequently never exposed to a high temperature.

It was, perhaps, mainly in consequence of this, that Stirling's engine, with its final improvements, required less oil and fewer repairs, worked with less friction, and was less liable to get out of order, when properly managed, than any steam engine.

Stirling's air engine employed to drive the machinery of the Dundee Foundry, was double-acting, having two receivers, one connected with the top and the other with the bottom of the cylinder. The plungers of those receivers were suspended by their rods from the opposite ends of a small beam. A reciprocating motion was given to that beam by means of a piece of mechanism which possessed a power of regulating the length of stroke of the plungers; and in its effect, though not in its construction, was analogous to the link motion.

The testimony of Mr. James Stirling to the advantages of this engine, was corroborated by that of the late Mr. Smith of Deanston, and by that of Mr. James Leslie.

20. *Efficiency of Stirling's Air Engine.*—According to Mr. Stirling, the air in his engine received heat at the temperature of 650° Fahr., and discharged the lost heat at that of 150° Fahr. The fourth example of the table in Article 10, shows that the efficiency of a theoretically perfect engine, with those limits of temperature, would be 0.45, and its consumption of coal 0·73 of a lb. per horse-power per hour.

It appears that the actual consumption of coal per horse-power per hour was about 2·2 lbs., being three times the consumption of a theoretically perfect engine, and corresponding to an actual efficiency of 0·15, or one-third of the maximum theoretical efficiency.

Stirling's air engine, therefore, was more economical than any existing double-acting steam engine,—probably indeed more economical than any possible double-acting steam engine. As compared, however, with a theoretically perfect engine, working between the same temperatures, it appears that two-thirds of its expenditure of heat was wasted.

21. *Causes of waste in Stirling's Air Engine.*—We shall now investigate the causes of waste in Stirling's air engine, according to the classification explained in article 12.

(1.) *Imperfect communication of heat from the burning fuel to the work-*

* In calculating the space to be traversed by the piston of an air engine, in which part of the air acts as a cushion, allowance must be made for the space through which this *cushion air* expands and contracts, with the variation of pressure, as well as for the space required for the changes of volume of the *working air*. The total space traversed is thus increased in a certain proportion, and the mean effective pressure diminished in the same proportion; so that the mechanical effect remains unaltered.

ing substance.—As the heating surface in Stirling's air engine consisted simply of the hemispherical bottoms of the receivers, it was of the worst form possible for exposing a large surface within a given space. A steam boiler of that form would occasion an enormous waste of fuel; it is probable, therefore, that this first cause of waste operated powerfully in Stirling's engine.

(2.) *Imperfect abstraction of the lost heat.*—It is probable that Stirling's engine was comparatively free from this cause of waste, for the cold water tubes exposed a large surface, and were abundantly supplied with water.

(3.) *The communication of heat to or from the working substance at improper periods of the stroke.*—This cause must have operated powerfully to occasion waste of heat in Stirling's engine, for the following reason: It is obvious, from the construction of the engine, that the air, whether being expanded or compressed, must have been continually circulating over the heated bottom of the receiver, and receiving heat through it from the furnace, at all periods of the stroke. Now it is only while the air is being expanded that the heat received by it is effective in producing power; while the air is being compressed, the heat received by it is detrimental. The heat received, therefore, by the air in Stirling's engine during at least one-half of each stroke—that is to say, probably one-half of the heat received—must have been absolutely wasted: it would be simply carried to the cold water tubes, and there abstracted, without producing any work. It is probable that, in an air engine free from such cause of waste of heat, a much smaller extent of cooling surface would be found sufficient to abstract the lost heat.

(4.) *Expenditure of heat in elevating the temperature of the working substance.*—In the air engine, the sensible heat of temperature is not, as it is in the steam engine, of secondary importance. If the temperature of the air in an air engine were elevated together by means of heat supplied from the furnace, the waste from this cause would be from three to four times greater than the latent heat of expansion which performs the work, and the economy of the engine would be entirely destroyed. Some persons, founding their calculations upon this supposition, have pronounced the air engine to be necessarily wasteful and inefficient.

The sensible heat in question might be entirely produced by an additional compression of the air performed during the process A, the power employed to effect such compression being developed by an additional expansion performed during the process C, in which the temperature of the air falls. To afford room, however, for the additional expansion, the bulk of the engine would have to be increased about five-fold, which would render it inconvenient in practice, especially for propelling ships.

The process actually pursued in Stirling's engine, of storing up the sensible heat by means of the economizer or regenerator, and using it over and over again, has already been generally described. In the original engine of the Rev. Robert Stirling, the regenerator consisted simply of the sides of the receiver and plunger, the latter being covered with a network of wires, in order to increase the surface; in the engine, as improved by Mr. James Stirling, it is composed of thin parallel plates of metal or glass. In Captain Ericsson's engine it consists of several sheets of wire gauze.

The efficacy of a regenerator to prevent expenditure of heat in raising the temperature of the air increases with its mass and surface; but no amount of mass and surface, how large soever, is sufficient to make it act with theoretical perfection. There is reason to believe, however, that both in Stirling's and in Ericsson's engines the masses and surfaces of the regenerators were sufficient to reduce the waste of heat, in raising the temperature of the air, to a very small quantity.

Some persons, overlooking the latent heat of expansion—the real source of power—appear at one time to have imagined that a theoretically perfect regenerator would prevent all expenditure of heat whatsoever, except losses by conduction and radiation. This amounted to representing Stirling's air engine as a machine for creating power out of nothing, popularly called a "*perpetual motion.*" It is very probable that the promulgation of that erroneous theory may have led scientific and practical men to regard the real performances of this engine as delusive, and may have been the cause which, notwithstanding its economy as compared with steam engines, prevented the extension of its use beyond the Dundee Foundry.

(5.) *Imperfect arrangement of the series of changes of volume and pressure.*—It is not likely that in Stirling's engine any material amount of waste arose from this cause, for the series of changes in question would be regulated by the relative motions of the piston and plungers; and those motions being susceptible of adjustment, as in the case of the piston and slide-valve of a steam engine, would be fixed, by trial, so as to act in the manner found to be most advantageous.

From all that has been stated, it appears,—that the principal causes of waste of heat in Stirling's engine were—first, deficiency of heating surface; and, secondly, communication of heat to the air during that part of the stroke when it was not being expanded;—that the latter cause was sufficient of itself to double, or nearly to double, the theoretical consumption of fuel; that the actual consumption of fuel was triple the theoretical consumption; but that, notwithstanding such defects, the engine was economical as compared with steam engines.

22. *Ericsson's Engine of* 1852.—In this engine the compression and expansion of the air were performed in two different cylinders, and at each stroke the air which had been used was expelled into the atmosphere, a fresh supply of air being at the same time taken in to perform the next stroke. This process of expelling the used air, and taking in fresh air, corresponded to the process C of the cycle; for the air expelled being, while in the cylinder, at a high temperature, was driven through a regenerator of wire gauze, and there left its sensible heat. This mode of working involved a great practical disadvantage, especially for marine purposes; for the cylinders had to be made large enough to contain the requisite supply of air at the ordinary atmospheric pressure, and the engine was consequently of enormous bulk and weight as compared with its power.

To proceed to the process D: It consisted in compressing the air with which the compressing cylinder had been filled to about two-thirds of its original volume, and forcing it into a receiver or magazine for compressed air. There was no provision in the compressing cylinder for abstracting the heat produced by the compression, and a certain waste of

power must have arisen from this cause, which will be again referred to in its order.

The process A, consisted in opening the induction-valve of the expanding cylinder, and filling that cylinder about two-thirds full of the compressed air. In the act of entering the expanding cylinder, the air passed through the regenerator which was fixed in the nozzle, and receiving the heat stored up there, had its temperature elevated. On the admission of the proper quantity of air, the induction-valve was closed.

The process B, consisted in the expansion of the air in the expanding cylinder, the latent heat being supplied from a furnace placed directly beneath the bottom of that cylinder.

The process C, was then recommenced by opening the eduction-valve, to allow the hot air to escape through the regenerator, and so on, as before.

23. *Efficiency of Ericsson's Engine of* 1852.—In calculating the efficiency of this engine, I have been guided chiefly by data contained in the report of Professor Norton (regarding him as a neutral inquirer). As nearly as I can judge, the efficiency of a theoretically perfect engine, working between the same temperatures, would be 0·404, corresponding to a consumption of 0·82 lb. of coal per horse-power per hour. According to Professor Norton, the actual consumption was 1·87 lb. of *anthracite*, being equivalent to 2·8 of bituminous coal, if 3 lbs. of bituminous coal of the quality specified in this paper be taken as equivalent to 2 lbs. of anthracite. This is about 3·4 times the consumption of a theoretically perfect engine, and corresponds to an actual efficiency of 0·118, being less than the maximum theoretical efficiency in the ratio of 0·295 to 1. The waste of heat and power, therefore, in Ericsson's engine must have been very great, though it was economical of fuel as compared with steam engines.

24. *Causes of waste of heat in Ericsson's Engine of* 1852.—(1.) *Imperfect communication of heat from the furnace to the air.*—This cause of waste of heat must have operated to a great extent in the engine in question; for the heating surface was simply the bottom of the expanding cylinder; at the same time an extensive heating surface was rendered doubly necessary by the low pressure of the air; for, as was long since shown by Dulong and Petit, the power of gases to receive and communicate heat increases with their pressure.

(2.) *Imperfect abstraction of the lost heat.*—It has already been stated that there was no provision for abstracting the heat produced in the compressing cylinder; the direct effect of this would be to cause an additional and unnecessary expenditure of power in compressing the air.

(3.) *Communication of heat to the air at improper periods of the stroke.*—This cause of waste must have operated to a considerable extent; for the air, after having performed its work, and while in the act of being discharged into the atmosphere, continued to circulate over the heated bottom of the cylinder, and must have carried away a considerable amount of heat. This heat would not be stored in the regenerator, which must have received no more heat from the escaping air than had been previously abstracted from it by the air when entering, or otherwise the temperature of the regenerator would have gone on continually rising.

(4.) *Expenditure of heat in raising the temperature of the air.*—There is reason to believe that in Ericsson's engine, as in Stirling's, the regenerator was adequate to prevent any considerable waste from this cause.

(5.) *Improper arrangement of the changes of volume and pressure.*—There is no reason to believe that any material waste arose from this cause.

It may be observed that Ericsson's engine, as well as Stirling's, was absurdly represented by some parties as a "*perpetual motion.*"

(To be Continued.)

For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. Howson, Civ. Eng.

It has been repeatedly and truly remarked, that no branch of mechanical engineering has been so much neglected as that relating to the manufacture of implements for farm purposes. But comparatively few years have elapsed since the only instruments used in tilling the soil, gathering crops, and other indispensable requisites attending agricultural pursuits, were those of the most simple and primitive forms; instruments, such as we have every reason to believe were used by the ancients and handed down from father to son, without any material alteration of form, and with but trifling improvements as regards general utility.

The introduction of the steam engine gave an impetus to mechanical ingenuity, which developed itself with a rapidity unexampled in the history of the world. Gigantic projects and wonderful results followed each other in quick succession. Steam navigation had ceased to be looked upon with admiration and astonishment, railways had become an actual necessity. A revolution had taken place in the manufacture of almost every article necessary for man's requirements. Implements of war even had been improved upon and rendered more ingeniously deadly, and yet the farmer plodded on in his old fashioned style, loth to believe that his time-honored implements could be advantageously altered or improved upon. We may attribute this neglect to two sources: first, the mistaken but pardonable vanity of inventors, who expended their ingenuity on subjects from which more extensive and profitable results were likely to follow than that of scheming agricultural machinery; secondly, the still more mistaken and less pardonable obstinacy of the farmers themselves, who continued to adhere with a dogged pertinacity to a class of implements far behind the age.

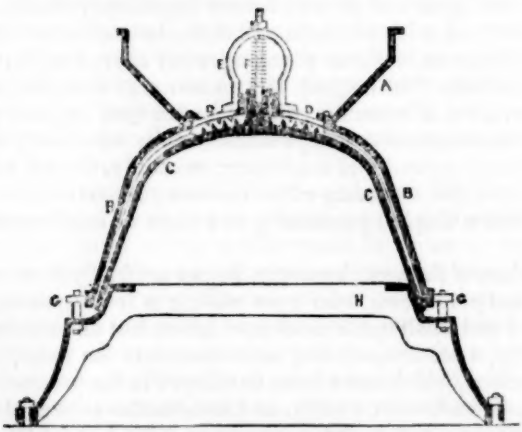
A new class of farmers, however, began gradually to appear. Men of education and perception, who were willing to look upon agriculture not as a defined and unalterable process of labor, but chemically, as well as mechanically, a science, offering inducements to the industry and talents of the ingenious, which have been developed in the production of a class of implements endless in variety, and inestimable as regards utility.

Machinists engaged in the construction of fine and elaborate works, are too apt to suppose that but little circumspection is required in designing machinery for farm purposes. This is a great mistake, however, for if minute exactitude is not absolutely necessary, lightness, cheapness,

durability, and efficiency, are the unavoidable requirements in producing that class of implements. The annexed engravings of

A Corn and Cob Mill, Patented by R. D. Granger, Esq.

In September last, will afford a good example of the careful manner in which the four above mentioned elementary requisites have been brought



to bear on a class of machines which, although but recently brought into general use, have now become indispensable to all the best appointed farm yards of this country.

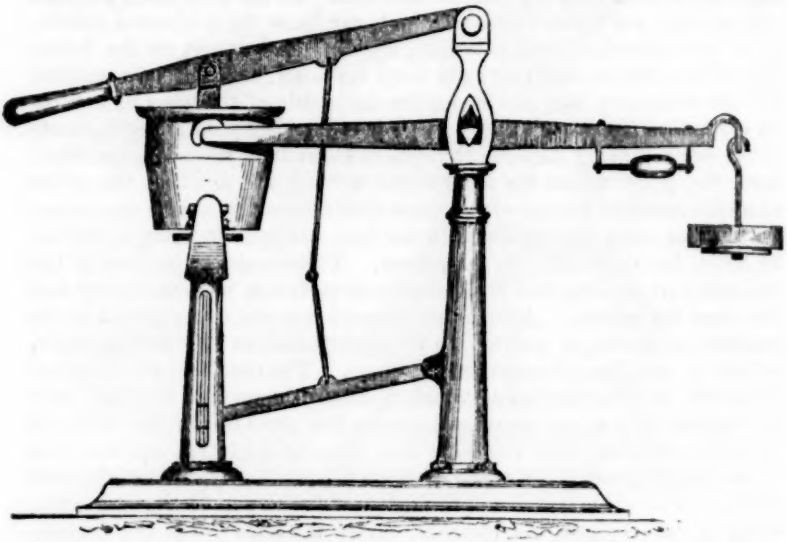
On reference to the sectional view, A, is the hopper secured to the outside shell B, the upper rounded portion of which, is connected to a central hub by four or more arms D. C, is the stationary burr, having on the top a spindle fitting easily in, and projecting through the central hub. In the top of the spindle is cast a screw, the upper end of which passes through the top of the arched piece E, the latter being secured to the arms D. A spiral spring F, surrounding the screw, intervenes between the top of the spindle and underside of the arched piece. H, is a cast iron ring fitting accurately to the inside of the stationary burr, and to this ring are cast or otherwise secured, the legs of the machine. To the projecting portions of these legs, are secured pins on which run loose the horizontal rollars, G, the peripheries of which bearing against the belt cast on the lower edge of the outside shell, serve to keep the latter, as it revolves, central with the stationary burr C. From the underside of the arms D, and on the arched top of the stationary burr project detached pointed teeth, those on the arms passing between the spaces formed by those on the burr. From the point where the arms D join the outside shell, to the point where the rounded portion of the same meets the straight sides, are coarse sharp edged teeth, and the same on the burr, arranged in straight lines on the latter, but diagonally on the former. The remaining portions of the shell and burr are furnished with similar teeth, coarse towards the top and finer near the bottom. A triangular shaped wooden frame shown in the perspective sketch, is secured to projections cast on the outside shell, and serves as a lever for turning the same. The corn and cob together is thrown into the hopper A, which is caused to revolve together with the outside shell B, and passing between the arms D, is acted upon by the teeth projecting from the same and those on the top of the burr; the material then passes to the coarse teeth on the rounded portion of the shell and burr, where it becomes sufficiently triturated to pass to the finer teeth, which further levigate the material, before it passes out at the bottom. The spiral spring F, has a tendency to keep the outside shell from too close contact with the stationary burr, the distance between each being regulated by the nut on the top of the arched piece E, so that the mill may be arranged to grind fine or coarse at pleasure. The efficiency of this mill is no doubt owing to the peculiar arrangement of breaking and grinding teeth, those on the rounded portion of the shell and burr acting on the kernel with a triturating effect, which rapidly breaks them into pieces of sufficient minuteness to be acted upon by the finer teeth below. The whole machine is light and easily removed from place to place, and the castings are made with such accuracy, that after the sand is removed from their surfaces, they can be fitted together at once without the use of files or drills. Although capable of grinding from ten to fourteen bushels of feed per hour, the mill, complete for operation, can be retailed at the low price of $30.

Among farm operations, such as appertain to the dairy have not been overlooked by inventors. Churns, especially, have received more than ordinary attention at their hands. At one time the struggle for supremacy in this class of implements had arrived at such a feverish pitch that the earnest competition has been termed the American churn mania. Some 250 patents for churns have been granted by the United States office

up to the present time, from which it would appear that something approaching to perfection must have ere this been arrived at, in the designs of these valuable instruments. After the cream had been rapidly and effectually converted into butter, some labor saving process of forming the same into blocks of accurate weight for the market had yet to be contrived.

Reinert's Apparatus for Weighing and Stamping Butter.

For effecting this purpose a simple and ingenious machine was invented and patented by W. S. Reinert, in May, 1854, a side view of which is represented in the annexed engraving. A beam somewhat similar to



that of an ordinary pair of scales, is supported on a column secured to a base plate. On one end of this beam is the weight and an apparatus for adjusting the same. The other end is forked so as to embrace the cup or mould for receiving the butter, the cup having lugs on the side which rest on the ends of the fork. On each side and towards the bottom of the cup, are two other lugs, between which are projections from the forked ends of a second column. The latter is hollow for receiving a vertical spindle, on the top of which is a disk, the bottom being connected to a lever which has its fulcrum on the main column. Immediately above the centre of the beam, and on the top of a continuation of the main column, is the swivel joint of the stamping lever, which is arranged to turn laterally at pleasure. The end of the lever is furnished with a handle for the operator, and immediately above the cup with a jointed rod having on its end a disk, to which is secured the wooden stamp carved with the device required. The stamping and lower levers are connected together by means of a light chain or jointed rod, and the cup is furnished with a false bottom, which, together with the inside of the cup, is enamelled. The stamping lever with its disk removed from the cup is, by means of the swivel joint, removed on one side, and the butter placed in the cup, to the requisite amount indicated by the sinking of the same, as far as the lugs and projections on the forked column will allow. The stamping lever

is now turned until the disk coincides with the cup, and is then brought down, so that the disk may stamp and compress the butter, which assumes a form similar to that of the cup. The lever is now raised nearly perpendicular, giving through the connecting chain a movement to the lower lever, which raises the perpendicular rod in the column, and causes its disk to elevate the false bottom, and with it the butter above the top of the cup, from whence it may be easily removed. The machine is now ready for a second operation. It will be easily seen with what rapidity butter may be weighed and branded, at one operation, by the use of this neat apparatus.

(To be Continued.)

THE CAMDEN AND AMBOY RAILROAD ACCIDENT.

Report of the Executive Committee to the Joint Board of Directors of the Delaware and Raritan Canal and the Camden and Amboy Railroad and Transportation Companies.

BORDENTOWN, SEPTEMBER 10, 1855.

GENTLEMEN:—On the morning of the 29th of August, the ten o'clock train from Philadelphia for New York, left, as usual, the depot at Camden, in charge of Isaac Van Nostrand, one of the most experienced and best conductors in the employ of the Railroad Company. Mr. Van Horn, the agent of the company, whose duty it is to see that all is right before the train starts from Camden, examined the bell-rope of the ten o'clock train on the morning of the 29th of August, a short time previous to its departure from Camden, and found it right.

The train immediately thereafter proceeded to Burlington, where it arrived safely and in time. The 8 o'clock train from New York, which was then due at Burlington, had not made its appearance, having arrived at New Brunswick behind time. The regulation time of the Philadelphia train at Burlington having expired, and the conductor having ascertained by telegraph, that the New York train had left Bordentown at 10·56 o'clock, he proceeded with the ten o'clock train, as he had done on all previous similar occasions, under the assurance that there was no hazard of collision, because the track was for the most part level and straight, and both trains were known by their respective conductors to be on the track and approaching each other.

There was no collision.

The result proved that the regulation of the Company was a salutary one, enabling the conductor to expedite his train without the least danger of collision.

As anticipated, the trains came in sight of each other where the track was straight, and, as usual, they both halted; and the Philadelphia train, blowing its whistle, commenced backing at about the rate of fifteen miles per hour, for the nearest turn-out; whilst all the employees of the train were keeping a vigilant look-out for obstructions on the road, and attending to the brakes.

The whistle was repeatedly blown, and the employees steadily engaged watching the track, on which cows had been seen as the train was

passing up, until the cross-road where the collision took place was reached; when of a sudden a pair of horses attached to a carriage, were driven at the rate of eight or ten miles an hour on the track, so near the train, as to render it impossible to check its speed, or in any way to prevent the melancholy collision, the fatal results of which are already known to you. From the outside line of the railroad to the car which struck the horses, is twenty-nine feet, which, at the speed of ten miles an hour, would require less than two seconds to pass. How impossible, therefore, is it to devise means for the protection of railroad trains from so sudden and unforeseen obstructions. The safety of the trains can be best secured by requiring all persons, before crossing a railroad, to stop and ascertain whether the road is clear.

The 29th of August was a still day; there was but little wind, and the whistles of both trains, which were blowing as they saw each other, must have been audible all along the road on which this carriage was traveling from the river, about a mile to the crossing. Besides the repeated blowing of whistles, as sworn to by some of our most respected citizens, from the time the up train first passed the cross-road until its return, and the fatal collision occurred; there was at the crossing a board, with the inscription, "Look out for the locomotive."

The entire truth of the foregoing narrative is, we think, fully, completely, and satisfactorily proved, by the testimony of fourteen reliable men, taken before the Coroner's Jury; and it does appear to your committee that in all particulars the law of the State and the regulations of the Company were fully complied with by these agents and employees having charge of the trains on the 29th of August. The Coroner's Jury, it is true, say that the engineer did not observe the rules and the law respecting blowing the whistle. But they must have rejected the positive testimony of the following witnesses: Samuel S. Stryker, of Trenton; James Garwood, Dean Swift Read, Charles Alcott, Henry Henner, John R. Rodgers, John Rodgers, Hugh Costill, of Burlington; Allen Thompson, Lloyd Vandeveer, Prescott Harvey, Israel Adams, Samuel Scott and Maurice Maxwell, all of whom, except the three last, were entirely disinterested, and unconnected with the company, whose respectability and position forbid the idea that they could have been mistaken; to find that the whistle was not blown because other witnesses did not hear it, they reject positive proof of the fact, and assert that it did not take place, because others were not cognizant of its occurrence; this certainly is a most extraordinary conclusion.

The proper look-out on the part of the brakemen, conductor, and engineer, was observed; the speed was usual and lawful; the warning whistle was sounded, and all due diligence, vigilance and precaution were studiously and scrupulously practised. The train had the right to the track, and the engineer and brakemen were on the look-out along the line of the track. There their attention was required and was given. They were not bound to look to the right or to the left, at a distance from the track, nor is it compatible with safety, where there are usually so many cattle on or near the road, that their attention should thus be diverted. Their business is to concentrate their vigilance on the track. But it is quite evident that the scope of their vision, while thus directed

would take in sufficient space to cover all objects within dangerous proximity to the track, except in just such a case as the one now under consideration, of headlong, impetuous, reckless velocity, precipitating an obstruction far beyond the scope of their vision, immediately in front of the train.

From such a case of intruding obstruction, unless apprized beforehand of the probability of its occurrence, it seems hardly conceivable how railroad trains, with any degree of vigilance, can protect themselves. Besides, had the brakeman observed the horses and carriage approaching upon the cross-road, is it probable that he would have deemed it necessary to warn the engineer? Could he have deemed it possible that any sane man, in possession of the senses of hearing and seeing, did not see and hear the train, and would not have held up short of the railroad track—especially as the ground was clear and smooth, and nothing to prevent the driver, even after he got close to the railroad, pulling his horses around to the right? "A quick check of the right rein would have thrown his horses parallel with the track," and avoided all danger. On the contrary, had the brakemen seen the carriage approaching, well knowing that the train had the right to the track, it is not presumable that he would have considered it necessary to give the engineer notice of its approach. If he had seen a cow or horse or other brute animal, *controlled only by his own instinct*, on, or approaching the track, he would have attempted to check or to accelerate the train. But if he saw at a distance those animals, apparently under the power and *control of human reason*, no danger was fairly to be apprehended. The law of the land, the dictates of common sense, and the demand of the traveling public, alike forbid the necessity of checking the train for every wagon that can be seen in the neighborhood of a track. There are two hundred and thirty-seven crossings by streets, public roads, lanes, and private crossings; the loss of one minute at each, would make the passage between New York and Philadelphia, eight hours instead of four hours.

There seems to be no reasonable doubt that the train was backing at a rate of speed not unusual or unsafe. This part of the track it must be remembered was straight, with new iron rails of 64 pounds to the yard, and in perfect order. It had just been passed over by the same train, and the track found safe and clear. Besides, there can be but little doubt that in meeting such obstructions on the road, that a higher rate of speed, which in case of collision would probably sweep the impediment off the road without injury to the train, is much safer than a low rate of speed, which would oblige the train to encounter and embarrass itself with the obstruction, without removing it from the track.

In view of the above facts, the Committee have reviewed the regulations of the Company, to ascertain if any, and what alterations could be suggested for the better protection of the passengers and trains; and they are constrained to say that they consider the present regulation better than any which has been proposed for running trains on single track roads, and that experience has proved them to be so, even in the recent case of disaster; because it is evident that it was the driver of the horses who caused the accident. Was this not so? Had he been at home, there would have been no accident. He alone is responsible, and the wisdom

of the Company's regulations, and the faithfulness of the employees, will stand vindicated before the considerate judgment of an enlightened and moral people.

With this brief narrative of the circumstances attending the melancholy event of the 29th August, as proved before the Coroner's Jury, we might, perhaps, with propriety close this report. The subject, however, of safety on railroads is so connected with the feelings and business of our people, that it calls for a few additional remarks from us. To say that the Company is responsible for this accident because they have not built a double track, is to apply a rule to this Company, which is applied to no other companies. There are supposed to be now more than twenty thousand miles of railroad in operation in the United States, and but a small proportion of double track. Roads which carry many more passengers per annum than the Camden and Amboy Railroad, have no double track. Even upon the New York and Erie, and Hudson River Roads, there are not double tracks through the whole line; and we are not aware that there is any railroad in this country, which is so exclusively appropriated for the carriage of passengers as this road is, that has a double track. It is a fact, however, not generally understood, that the Camden and Amboy Railroad Company have now and have had for many years, two separate and independent lines for the transit of passengers between New York and Philadelphia. A portion of their trains pass over one track exclusively, and a portion over the other; and it is well known that incipient steps have been taken to construct two more tracks between Trenton and New Brunswick; which, including the Philadelphia and Trenton Railroad, will provide additional facilities between New York and Philadelphia, not in the expectation of preventing accidents, but to expedite the transit between the two cities. Nothing but the depressed state of railroad securities in the money market has prevented the prosecution of this work.

It is held, however, by many, that double tracks are not that guaranty for safety which is claimed for them; the necessity of backing the trains, even on double tracks, in many instances, cannot be avoided; switches, the most frequent cause of railroad accidents, must necessarily be multiplied. Certainly the statistics of railroad accidents, in Europe as well as in this country, seem to favor that idea. It may be added, likewise, that on double tracks the temptation to maintain high rates of speed is almost irresistible, and that high rates of speed are not as compatible with safety as low rates. The public demand, with reference to railroad travel, safety, cheapness, and speed. Double tracks are indispensable where high rates of speed are in use. But they are not compatible with cheapness or necessary for safety, where a limited number of trains per day are run, as is the case on our road. If lightning from heaven were to strike our cars, it would be as reasonable to say that the company was responsible for the result, because they have not fixed lightning rods to each car, as to say that the company is responsible for the recent accident, because they have not built a double track. As to the suggestion of placing a gate at each crossing, that can only be done by the Legislative authority, and we do not think that it would be as safe, as to require every person to halt, and to see that the train is not in sight, before he attempts to cross any rail-

road, as is the evident intent of the present sign boards required by law.

Every person would, in this case, have a perfect protection in himself; why diminish it by placing the responsibility elsewhere, and upon persons much less interested? As long as wood and iron are so fragile and defective, there can be no absolute safety in traveling at the present speed with which our railroad trains are driven. We would suggest, however, that the best means to obtain the desired safety, would be to alter the whole system of hostile legislation in regard to railroads, to consider them as useful public conveniences, entitled to the liberal support and just consideration of the people, and to that protection from the courts and juries which every American freeman has a right to claim; not as nuisances to be reviled without measure, and to be libelled and persecuted on all occasions, right or wrong; to make them exclusive; to fence them in from one end to the other; to take the public roads under or over them; to reduce the speed of the trains to twenty-five miles per hour, and to hold all persons trespassers, who, without authority from the Company, go on the road or suffer their cattle to go on it.

ROBERT L. STEVENS,
EDWIN A. STEVENS,
JAMES NEILSON,
RICHARD STOCKTON,
ROBERT F. STOCKTON,
JOHN R. THOMPSON,
BENJAMIN FISH,
JAMES S. GREEN.

Railroad Accidents.

On the 29th of August last, the passenger train which left Philadelphia at 10 o'clock, A. M., for New York, met with an accident near Burlington which resulted in the death of 23 persons, and serious injury to about 70 more. On the 10th of September, the Executive Committee made a report on the subject to the Joint Board of Directors, published in the daily papers, which, we think, should not pass without notice from this Journal. For this purpose, we re-publish it in this number. In noticing it, however, it is not our intention to dwell upon anything which relates merely to the disaster itself; that is past, and if retribution is to be exacted, it must be in due course of law, which we have no desire to forestall by prejudging the case either to condemnation or acquittal of any one concerned. Nor shall we dwell upon the tone of the report in question, which has been complained of as cold and unfeeling: but we desire to advert to parts of it, in which opinions are expressed as to the possibility of lessening the liability to accidents upon this and other roads, and the means to be used for such a purpose. For this purpose we accept the account of the accident given in the report, and shall follow the discussion.

In the first place, the Committee find in the circumstances of the accident, an argument in favor of the regulation of their road, by which, after a train has waited for an opposite one for a certain length of time, it may proceed; both trains having the right to the track, with the farther rule that when the trains meet, the one which has not reached the centre-post shall back to the next switch to allow the other to pass. The Committee maintain this as a good regulation, "as allowing the conductor to

expedite his train without the least danger of collision."—But we differ from them in this, thinking that the accident which happened upon this road a few years ago, near Spotswood, clearly proves that the regulation is far from obviating the danger of collision; in fact, the experience of other roads shows that the result of such a regulation, is to cause the engine drivers to use undue speed as they approach the centre-post so as to avoid the trouble and mortification of running back, and thus to increase the danger of collision. Nor do we think that the records of the Company will show that such a regulation facilitates the rapid passage of the trains, and the making the connexions with the lines running on from the termini; on the contrary, we know of no road which has been so much complained of, as this very road has been, on account of falling behind the time of the departure of the Baltimore trains from Philadelphia; an event of such frequent occurrence, as to have induced the project of a new road across New Jersey to pass from New York to Washington without touching at Philadelphia, and thus led the New York press to lose no opportunity of exciting the public indignation against the Camden and Amboy Company and the monopoly of transit which they enjoy under the laws of New Jersey. We believe that a much more efficient and safe regulation would be, to require at least the conductor of each train which had a connexion to make, to run punctually to his time, (a point in which this road is sadly defective,) and so to arrange the times of reaching and leaving each station, that there should be no danger of collision. With a line of telegraph all along their road, we cannot see how such danger could occur; for instance, in the present case, it is stated, that the conductor knew that the train from New York "had left Bordentown at 10 hours and 56 minutes;" why not wait at Burlington, then, until that train, which could not be far off, reached there—giving way to that train, which had a connexion to make at Philadelphia, while the train toward New York had none.

The Committee admit that the train was backing at the rate of 15 miles an hour, which they seem to consider a safe rate of speed, but surely they have overlooked the various sources of danger in backing a train of cars, arising from the position of the engine—the loose connexion of the cars together. We find in the regulations of other roads, that it is expressly forbidden, under any circumstances, to back a train more rapidly than 6 miles per hour; and certainly, any speed much greater than this, must be unsafe, for, in the first place, the engine driver being behind, cannot receive timely notice of any suddenly discovered obstruction, and indeed cannot, unless very especial care be taken, receive any notice at all, for the rope which passes between the cars and engine, is slackened at least a foot for each car, in consequence of the slacking of the couplings and approach of the cars to each other, and as it is knotted between each car and passes through small holes or rings, will not run readily so as to affect the bell, whilst the dust of the train obstructs the view of any one from the engine. Then, again, the pushing motion of the engine, transmitted through the buffers, tends at any obstruction upon a single rail, as, by the catching of a flange or the pressure on a curve, to force the cars off the track. The old experience on the subject of pushing trains, was sufficient to cause, we believe, its universal disuse, except when a

temporary necessity may arise upon a single-track railroad, and all experience seems to show that it is an expedient never resorted to without great danger, which danger increases very rapidly as the rate of speed is accelerated.

Another assertion of the report which strikes us as inaccurate, is that the engineer and brakesman "were not bound to look to the right or left, at a distance from the track, nor is it compatible with safety, where there are usually so many cattle on or near the road, that their attention should be thus diverted." On the contrary, when the engine-driver or brakesman know that they are approaching a crossing, we consider it as a very important part of their duty to give a careful scrutiny to the road so approached, especially when any one driving along that road would be apt to be misled into security by the recent passage of the train, which would seem to render the road clear from that quarter. The use of the whistle and a careful lookout seem to us essential in such a case, and if an accident should happen from neglect of them, we should, without hesitation, consider these officers as liable for its occurrence. (we do not mean to say, that such was the fact in this case, although the coroner's jury appear to have thought so.) But when the Committee go on to exclaim, "how impossible is it to devise means for the protection of railroad trains from so sudden and unforeseen destruction!" we must reply, no, gentlemen, there is a very simple and effectual way of fully guarding against the possibility of every such disaster—a way, which has been tested by experience, in countries where it is considered the duty of government to take human life under its protection, and should be required of you, and of all railroads running through thickly populated sections of country—it consists in passing all roads over the railroad by means of properly elevated bridges. This method would not be very expensive, certainly not too much so in view of the end to be attained; it would be, as it has always been found, effectual, and it ought to be adopted by all railroads: or if not willingly, then they should be compelled to adopt it by law. Until this is done, we agree with the Committee, that "the safety of the trains can best be secured by requiring all persons, before crossing a railroad, to stop and ascertain whether the road is clear."

The most extraordinary feature of the report, however, is the argument against a second track; they affirm that "the necessity of backing trains, even on double tracks, in many instances, cannot be avoided." How can this be the case, if the trains in one direction are kept on one track, and those in the other, upon the other, as in all well conducted roads they will be? The only case we can imagine, would be where a fast passenger train running for a connexion, should find itself obstructed by a train broken down on the track before it, and should run back to the nearest switch, pass on to the other track, and thus take the wrong track to pass the destruction. This would be a very dangerous method, but might be useful, and could be guarded only by despatching signals along the line before the backing train, and then running with extreme caution. Except in such a case, we cannot imagine the circumstances in which a train would have to be backed.

Another curious assertion is, that on a double track "switches must

necessarily be multiplied." But why? Switches are used for three purposes; first, to accommodate a local trade, allowing cars to run out and stand upon a side track; secondly, to permit a slow train to get out of the way and allow a fast train overtaking it to pass; thirdly, on a road with a single track, to allow trains running in opposite directions, to pass each other. In a double track road, receiving no cars except at the termini, and running all trains at the same velocity, no switches would be necessary, (except to provide for accidents and repair of track). The two first categories belong to both double and single roads, the third to single roads alone. The number of switches on a double track road may, therefore, be less than on a single one, provided it be judiciously run.

Is it true, moreover, as the report asserts, that a double track is not compatible with economy? Is it not, on the contrary, the result both of reasoning and experience, that the longer time during which the rails will last makes them more economical for permanent roads having a travel in both directions? It is true that most of our roads are obliged to be started with single tracks, and made to earn the means of laying the second, but this is not now the condition of the road in question, whose profits, from their monopoly and good management, (for their pecuniary interests,) have made them so rich. As to the comparison with the lightning rods, we would accept it, and say decidedly, that if experience had shown that railroad trains were liable to be struck, and the passengers endangered by lightning, the company who ran their cars without lightning rods, would be very culpable. Now experience has shown that backing cars are very liable to accident, and it should, therefore, be as far as possible, avoided.

The ordinary accidents on a railroad may, perhaps, be reduced to three categories—first, from breaking an engine or a car, and thus crushing the train; secondly, running over an obstacle, by which the cars are thrown off the track and broken; thirdly, collision with trains running in other directions. Against the first, there is no perfect remedy, and the danger can only be abated, not entirely destroyed, by constant examination. The second is the most fertile source of accident, and will remain so, so long as the farmers will allow their cattle to have access to the railroad track, and so long as our people are so reckless in the manner in which they pass on, to, and across it. After obstacles are guarded against as far as possible by fencing the road and passing all other roads across it at a different level, we fully agree with the report, that the best means of remedying the danger "would be to alter the whole system of hostile legislation, &c." So long as a farmer could claim damages for the loss of a cow, which must have been on the track by his own fault or negligence, or an individual who has been injured by placing himself in a danger of which he must be aware, could get a verdict against a railroad, whose servants could not, by any possibility, avoid the accident, there can be no hope of any important reduction in this class of accidents; but this state of things we trust is now at an end, and we hope soon to see all the courts in the land join to make the individuals in question responsible to the extent of their abilities, for the actual or possible damage in such cases to the train. Then accidents of this kind will almost disappear, for all parties will be made more cautious, and

the public mind will be more easily satisfied as to the fault of the engine driver or conductor. For the third class of accidents no effectual security can be found, except in a well-managed double track road; or if that be from circumstances, impossible, carefully digested rules, and the strictest authority exerted to compel the trains to run punctually to their time. Such a system would, we believe, render such accidents nearly impossible.

It appears to us, that the moral of the late fearful and deplorable accident which has furnished the text of these remarks is, first, the necessity of absolutely prohibiting any railroad from passing another road on the same level: Secondly, the necessity of legislation for the punishment of individuals who drive or ride across a railroad track, without first stopping to ascertain that it is clear: Thirdly, the expediency of so regulating the travel on railroads, that but one train shall have the right to the track at a given place and time, and of compelling all conductors to be punctual in their running.

Translated for the Journal of the Franklin Institute.

On the substitution of the Native Sulphate of Magnesia for Sulphuric Acid in the Manufacture of Hydrochloric Acid, Sulphate of Soda, Nitric Acid, and Chlorine. By M. Ramon De Luna.

In the experiments, the first results of which I have the honor of presenting, I proposed to myself both to economize the expense of transporting the sulphuric acid, and to find an industrial use for the sulphate of magnesia which is met with in several localites in Spain, especially in the province of Toledo near Madrid, along the line of the Mediterranean Railroad.

Manufacture of Hydrochloric Acid, and of Sulphate of Soda.—If a thorough mixture of two parts of crystallized sulphate of magnesia (or $1\frac{3}{4}$ parts of sulphate of magnesia slightly dried,) and one part of chloride of sodium be heated to redness, hydrochloric acid will be disengaged, and the residuum will be composed essentially of magnesia and sulphate of soda. Treated with water at 90°, (194° Fahr.) this residuum will yield, besides magnesia, sulphate of soda, and a little sulphate of magnesia which has escaped decomposition, the elimination of which may be obtained by the addition of the milk of lime, which will transform it into sulphate of lime, which is nearly insoluble, and magnesia. I have prepared by this process, more than 12,000 kil. (26,000 lbs.) of sulphate of soda, much purer than that of commerce.

Manufacture of Nitric Acid.—A mixture of two parts of crystallized sulphate of magnesia, (or $1\frac{3}{4}$ slightly dried) and one part of nitrate of potassa or soda, when heated to redness, yields nitric acid, accompanied by abundant nitrous vapors, sulphate of potassa or soda, and magnesia. From 200 grammes of calcined nitrate of soda, with 400 grammes of crystallized sulphate of magnesia, I obtained 90 grammes of nitric acid, marking 40° of Baume's areometer. When distilled, this acid yielded a colorless acid of 46°, and perfectly pure.

Chlorine may be obtained by heating strongly, a mixture of cloride of sodium, peroxide of manganese and sulphate of magnesia, as might be anticipated from the fact that these salts when heated alone yield hydrochloric acid. These actions, as will be seen, are the consequences of the little affinity which magnesia has for hydrochloric and nitric acids, compared with that of its analogues the alcaline and earthy bases; hence the sulphate of lime, so much more abundant in nature, cannot be used in its place, for these re-actions.

On the Existence of an Element of Strength in Beams subjected to Transverse Strain, arising from the lateral action of the Fibres or Particles on each other, and named by the Author the "Resistance to Flexure."

By Peter William Barlow, Esq., F.R.S.*

The author commences by observing, that under the existing theory of beams, which recognises only two elements of resistance, namely, tension and compression, the strength of a beam of cast iron cannot be reconciled with the results of experiments on the direct tensile strength, if the neutral axis is in the centre of the beam.

He then proceeds to describe experiments made on two solid beams of cast iron to determine the position of the neutral axis. The beams employed were 7 feet long, 6 inches deep, and 2 inches thick, on each of which small vertical ribs were cast, 12 inches apart; nine small holes were drilled opposite to each other in each rib, for the purpose of inserting the pins of a delicate measuring instrument. The distances of the holes of the centre division of both beams were measured under various strains, and the results show that the extensions and compressions proceed in an arithmetical ratio from the centre to the upper and lower sides of the beam; and that at any given distance on either side of the centre, the amount of extension is equal to the amount of compression.

The position of the neutral axis being thus conclusively ascertained to be in the centre, it is shown that, not only the ultimate strength, but also the amount of extension and compression with a given strain, indicates the existence of another element of resistance, in addition to the resistances to extension and compression.

The author then points out, that in applying the law of "*ut tensio sic vis*" to contiguous fibres, under the different degrees of extension and compression, the effect of the lateral adhesion has been omitted, and each fibre has been supposed to be capable of taking up the same degree of extension or compression as if it acted separately, and independently of the adjoining fibres.

It is then shown that this supposed independent action of the fibres is inconsistent with other practical results, and evidence is exhibited of a powerful lateral action when unequal strains are exerted.

From these and other considerations, the author is led to think that the effect of the lateral action, tending to modify the effect of the unequal and opposite strains in a beam, constitutes, in effect, a "resistance to flexure" acting in addition to the resistances of tension and compression.

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

In order to ascertain whether the apparent difference in the amount of tensile strength when excited by direct and transverse strains is due to *flexure*, the author caused open beams or girders to be made, each of which was formed by two bars of metal; the upper and lower bars of the same beam were in every case of the same form and dimensions; but the depth of metal and the distance to which the bars were separated vertically, was varied in the several forms of girder experimented upon. By these means the bar forming the lower side of each girder was torn asunder under different degrees of flexure. The different forms of girder experimented upon were of equal length, and were compared with solid beams and with bars of the same metal broken by direct tensile strain.

From the mean of *four* experiments on each form of girder, the value of the total resistance at the outer fibre is ascertained, and exhibits the following results:—

1. In girders having the same depth of metal, namely, about 2 inches, but the total depth of the girder, and consequently the deflections different:—

Form of beam or girder.	Depth of girder.	Deflection.	Total resistance at the outer fibre.
			lbs.
No. 1. Solid beam, .	2·02	·670	41,709
No. 2. Open girder, .	2·51	·510	35,386
No. 3. Open girder, .	3·00	·401	31,977
No. 4. Open girder, .	4·00	·301	28,032

2. In girders having the same total depth (namely, 4 inches,) and consequently nearly the same deflection, but differing in the depth of metal:—

Form of beam or girder.	Depth of metal.	Total resistance at the outer fibre.
		lbs.
No. 5. Open girder, .	3·01	37,408
No. 4. Open girder, .	1·97	28,032
No. 7. Open girder, .	1·56	27,908
No. 6. Open girder, .	1·48	25,271
The tensile strength of the metal employed was found to be		18,750

From these experiments, the particulars of which are fully detailed, the following facts are elicited:—

1. That in all cases the total resistance at the outer fibre, at the time of rupture, is greater than the tensile strength.

2. That in girders having the same depth of metal, it increases when the deflection increases; and

3. That in girders having the same total depth, and the same deflec-

tion, the resistance is greater when the depth of metal in the beam is greater.

And it follows that there is an element of strength depending on the depth of metal in connexion with the deflection; or, in other words, dependent on the *degree* of *flexure* to which the metal forming the beam is subjected.

The author next proceeds to examine the law under which this resistance varies; and considering the total resistance in the solid beam to be composed of two resistances, one being constant and due to the tensile strength, and the other variable and depending on the depth of the metal in connexion, with its deflection, the experiments indicate that the resistance to flexure varies, throughout all the girders, directly as the amount of deflection into the depth of the metal.

The paper concludes by pointing out the important amount of this resistance, the operation of which has been hithereto unknown, and which in cast iron exceeds the tensile strength of the metal, and shows that comparisons of the strength of different forms of section, based on the existing theory, which assumes the resistance at the outer fibre to be constant and equal to the tensile strength of the metal, must be entirely fallacious.

The paper is accompanied by full details of all the experiments, and the measurements for determining the position of the neutral axis.

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*On the Influence of Local Altitude on the Burning of the Fuses of Shells.**

In the early part of the year 1848, at the annual practice of the Artillery in this garrison, it was observed that the fuses burned too long a time. The regular burning of fuses being a matter of much importance, the circumstance was duly reported to Artillery Head Quarters, and a portion of each kind was directed to be sent to St. Thomas's Mount (eight miles from Madras and on the same level) for examination, where they were found to burn correctly, and as at that time no one suspected the real cause of the discrepance, it was concluded there had been some error in the length of our pendulum, and there, for the time, the matter rested.

But as I was satisfied, for many reasons, that it was not owing to an error in the pendulum, I determined to keep the subject in mind, and for the practice in the following year, (1849,) I caused to be made an adjustable pendulum which beat seconds very correctly for several minutes. This pendulum was daily compared with two or more seconds watches to make all safe, and, as our longest time of flight did not exceed twenty seconds, no error could possibly arise from this source. The result was that the fuses again burnt too long at Bangalore, and were again found to burn correctly at St. Thomas's Mount.

This was a mystery to all; but after the matter had cost me much thought, it occurred to me that the cause was to be sought in the difference of altitude between St. Thomas's Mount and Bangalore, nearly 3000 feet; and as a means of putting this to the test, I suggested that

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

some fuses should be burnt at the Mount, or at Madras, under a receiver, exhausted until the barometer stood at the Bangalore mean height, or about 27 inches. This, however, it was not found convenient to do; but, as an equally satisfactory way of testing the accuracy of my conclusions, a small number of fuses were prepared and burnt at St. Thomas's Mount, at Bangalore, and at two different altitudes on the Neilgherry Hills, as will be seen by the annexed copy of an official memorandum; and, although this experiment was too limited to enable us to compile a scale of the probable times a certain length of fuse composition would burn at given altitudes, it amply proves the fact that combustion is retarded at considerable elevations.

Memorandum of an experiment to ascertain whether the atmosphere influences the burning of fuses:—

Eighteen 8-inch fuses, made of the same description of wood (Congo,) were filled with composition made for the purpose. The same man drove the whole on the morning of the 2d August, 1849, using the same mallet and drifts. Six of the fuses were burnt at the Mount, six at Bangalore, and six on the Neilgherry Hills; all in the presence of artillery officers; the result is shown below:—

Time.	Station.	Length of fuse.	Time of burning.	Barometer.	Thermometer.	Height above the level of the sea.
		ins.	secs.	ins.	°	
August 2, 1849. ½ past 12 o'clock.	St. Thomas's Mount.	3	14·15	29·78	89	Artillery Depot yard.
		3	14·30			
		3	14·30			
		3	14·30			
		3	14·15			
		3	14·30			
August 17, 1849. ½ past 5 P. M.	Bangalore.	3	16·00	26·89	82	3000 ft.
		3	0·0*			
		3	15·75			
		3	15·15			
		3	15·75			
		3	16·25			
August 31, 1849. ½ past 7 A. M.	Kotagherry, Neilgherries.	3	17·00	24·025	Att. 62·7 Det. 61·8	6500 ft.
		3	17·00			
		3	0·0*			
		3	17·30			
Sept. 8, 1849. 20 minutes past 8 A. M.	Cotacamund, Neilgherries.	3	18·00	23·030	54·2	7300 ft.
		3	18·25			

The writer attributes the result to the rarity of the atmospheric air, and of its constituent oxygen at the higher stations.

*The fuses thus marked, accidentally ignited at both ends.

On the Position of Aluminum in the Voltaic series. By CHARLES WHEATSTONE, Esq., F. R. S.*

Having, through the kindness of Dr. Hofmann, been permitted to examine a specimen of aluminum prepared by M. Claire-Deville, I availed myself of the opportunity to ascertain one of the physical properties of this extraordinary metal, which it does not appear has been yet determined, viz: its order in the voltaic series. The following are the results of my experiments.

Solution of potass acts more energetically and with a greater evolution of hydrogen gas upon aluminum, than it does on zinc, cadmium, or tin. In this liquid aluminum is negative to zinc, and positive to cadmium, tin, lead, iron, copper, and platina. Employed as the positve metal, the most steady and energetic current is obtained when it is opposed to copper as the negative metal; all the other metals negative to it which were tried became rapidly polarized, whether above or below copper in the series.

In a solution of hydrochloric acid aluminum is negative to zinc and cadmium, and positive to all the other metals above named. With this liquid also copper opposed to it as the negative metal gave the strongest and most constant current.

Nitric and sulphuric acids, are known not to act chemically in any sensible manner on aluminum. With the former acid diluted as the exciting liquid, aluminum is negative to zinc, cadmium, tin, lead, and iron. The current with zinc is strong; with the other metals very weak, and it is probable that their apparent negative condition is the result of polarization. When aluminum is immersed in dilute sulphuric acid, this metal appears negative to zinc, cadmium, tin, and iron, but with lead, on which sulphuric acid has no action, the current is insensible. In both these liquids copper and platina are negative to aluminum, and notwithstanding the apparent absence of chemical action on the latter metal, weak currents are produced.

It is rather remarkable, that a metal, the atomic number of which is so small, and the specific gravity of which is so low, should occupy such a position in the electromotive scale as to be more negative than zinc in the series.

Monster Mortar Guns.†

The *Horatio* steam frigate is preparing, at Sheerness, to receive two of the monster mortar guns invented, and it would now appear already constructed, by Nasmyth. These guns are 10 feet 6 inches long, and in diameter at bore, 13 inches; muzzle, 31½ inches; base, 40 inches. The weight of each is about 23 tons. It is slung on Captain J. Robert's plan, and will throw a solid spherical shot of 302·4 lbs. with a charge of 30lbs. of powder. The construction of the bomb-proof iron-cased floating mortar-vessels has been kept very quiet, but we now learn that they are

* From the Lond., Edin. and Dub. Philos. Mag., August, 1855.

† From the London Builder, No. 632.

of exactly the same construction as the broadside iron cased batteries carrying sixteen Lancaster guns. The upper deck is so strengthened as to bear the weight of the heavy piece of ordnance with which it is armed. These mortar vessels, it is said, will throw bomb-shells a distance of four miles! With their guns, ammunition, and stores on board, the floating batteries will only draw 20 feet of water, so that the whole fleet of *forty* vessels can approach within a comparatively short distance of any of the marine Russian fortresses. Their cost has been enormous. A fleet of English and French line of battle-ships and smaller craft will accompany them. The mortar batteries are each 70 feet in length, 23 feet in width, and 9 feet 4 inches in depth. Several of these mortar batteries will be attached to the fleet of forty floating batteries propelled by steam. Their construction in the hull is the same, and their decks are bomb-proof. That they are destined for the Black Sea as well as the Baltic, we are still hopeful, though no official hint has even yet appeared to that effect that we are aware of. The British fleet for the Baltic will consist, it appears, of no less than a hundred vessels, every one of them propelled by steam.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, October 18, 1855.

John C. Cresson, President, in the chair.

John Agnew, Vice President.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A letter was read from the American Institute of New York, inviting the Institute to visit their Exhibition by delegation. The President was authorized to appoint a delegation.

Donations to the library were received from The Geological Society of London, and The Statistical Society, of London; Professor A. D. Bache, Washington City, D. C.; The Pottsville Scientific Association, Pottsville, Pennsylvania; Professor John F. Frazer, and Mr. P. S. Sanderson, of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of September.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by 65 gentlemen were read and accepted.

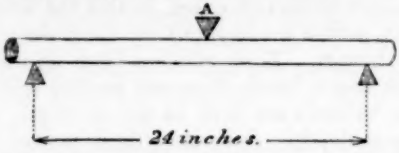
The candidates for membership in the Institute, (12,) were proposed, and the candidates proposed at the last meeting, (7,) were duly elected.

Mr. John E. Addicks, Chairman of the Committee on Exhibitions, offered the following resolution, which was adopted:

Resolved, That in consequence of being unable to procure suitable accommodations, the Institute is forced to decline holding an Exhibition for this year.

Mr. Macpherson stated, that wishing to obtain a strong composition mixture to be used for marine purposes, he had recently made the following experiments:

All the bars being turned to a diameter of $2\frac{1}{16}$ inches, and a length of 25 inches, the weight being applied at A, as shown:



No. 1, was composed of 10 lbs. copper, 10 oz. tin, 12 oz. zinc, 8 oz. lead, deflected quickly to $7\frac{5}{8}$ inches, and broke with 6874 lbs. at A.

No. 2, was composed of 6 lbs. copper, 4 lbs. zinc, deflected slowly to 2 inches, and broke with 6489 lbs. at A.

No. 3, was composed of 2 lbs. copper, 1 lb. of zinc, deflected quickly to $7\frac{9}{16}$ inches, and broke with 6158 lbs. at A.

No. 4, was composed of 9 lbs. copper to 1 lb. of tin, deflected slowly to $4\frac{1}{4}$, and broke with 7802 lbs. at A.

No. 5, was composed of 10 lbs. copper, 1 lb. of tin, 4 oz. zinc, deflected slowly to $7\frac{1}{2}$ inches, and broke with 10,530 lbs. at A.

No. 6, same mixture as No. 5, cast several weeks later, deflected very slowly to $7\frac{1}{2}$ inches, and sustained without breaking or showing the least fracture, a weight of 11,695 lbs. at A.

No. 7, was composed of $8\frac{1}{2}$ lbs. of copper, 8 oz. tin, 1 lb. zinc, deflected slowly to $5\frac{3}{8}$, and broke with 6461 lbs. at A.

No. 8, same mixture as No. 1, with the addition of 1 lb. tin to every 12 lbs. of the mixture, deflected very slowly $\frac{1}{4}$-inch, and broke with 5333 lbs. at A.

A piece of refined bar iron of same length and diameter, deflected slowly to 4 inches, and sustained at A, a weight of 12,375 lbs., and by increasing the 17,000 lbs., it deflected to $5\frac{1}{2}$ inches.

Mr. Macpherson exhibited specimens illustrating the results of these experiments.

Mr. M. B. Dyott exhibited a model of his improvement in warm air furnaces. This is at present under consideration by the Committee on Science and the Arts.

BIBLIOGRAPHICAL NOTICE.

New Canadian Mint Bill: International Coinage. Legislative Assembly of Canada, third and fourth report of Standing Committee on Public Accounts, W. L. Mackenzie, Chairman, ordered to be printed 12th April, 1855. Quebec, 8vo. 1855.

The tendency of the world at present seems very emphatically towards an abandonment of ideas, which have no longer any realities to support them, but are clung to merely from old habit and association; and to-

wards the surrender of usages which have grown effete, and are no longer adapted to the practical demands of society. This tendency is not so much the fruit of reflection as the suggestion of convenience; it does not spring from within, outwards; but is probably a re-action from without, inward; and is motivated by the vastly increased intercourse, which the mechanical improvements of the last quarter century have allowed between almost all parts of the world, and which not only demands for its accommodation an assimilation and uniformity of symbols, but produces them.

It is in this way, by running to and fro, that knowledge, as the Scripture says, is increased; in this way, that the prophetic anticipations of divers closet speculators are discovered to be highly utilitarian, and that the trenchant ideas of the French geometers sixty years since—ideas wholly inapplicable and impossible in the then state of things, only now beginning to be carried out in their fulness over the restricted territory of France—will find their practical development. Mere theory or mere geometry can do comparatively little; and Man, (i. e. masses of men) is led by convenience and association.

This seems to be illustrated in the recent money-movement in Canada, referred to in the caption above. Twenty years ago, the movement was begun; actuated by a desire to remedy a commercial state, no less confused and inconvenient than the present, but then without success; now, the agencies of steam and electricity, the construction of railroads between the United States and Canada, and the recent adoption of the Reciprocity Treaty, have promoted such a diffusion of intercourse between the Republic and the Province, that the population of the latter seem to be almost unanimous in their wish to assimilate their own currency to that of the former.

It was very natural, in the early Provincial settlements and arrangements, that the same method of accounts should be used, as in the Mother Country. But the intercourse of the Provincialists, individually, came gradually to be far less with that Mother Country than with the neighboring States, where different methods prevailed; and so the £ sterling and its irregular subordinates grew less familiar than the American denominations and a decimal subdivision. It is useless to speculate on the curious probable destiny of the Dollar, to become hereafter the universal nominal unit of value and exchange, and equally unnecessary to detail the advantages of the decimal over the duodecimal count. The latter are so manifest, that the natural tendency of assimilation which would any how have shown itself, was greatly facilitated; until, in point of fact, the greater part of Canadian business-ideas repose upon the Dollar, even though in conformity with law, it has to be translated, for actual transactions, afterwards into pounds, shillings, and pence.

In order to render such translation more ready, and also from a want of a sufficient circulation of sterling coins, (which produced the same result in Canada that it has ever done in all colonies, viz: an appreciation of actual coin,) a pound currency was devised, which should be an integral multiple (four) of the dollar; and it is with this £ which represents $ 4. U. S. while the £ stg. is $4·86⅔, that the public accounts in Canada are kept. In point of fact, the last act on the subject, that of 1853, goes